MRMS/Q2/RUA

Ken Howard OAR/NSSL

Steve Lord NWS/OS&T

Subject Areas

MRMS – Multiple Radar Multiple Sensor (RITT, 2009)

http://wdssii.nssl.noaa.gov/

Q2 – Advanced Precipitation Product Suite and development environment

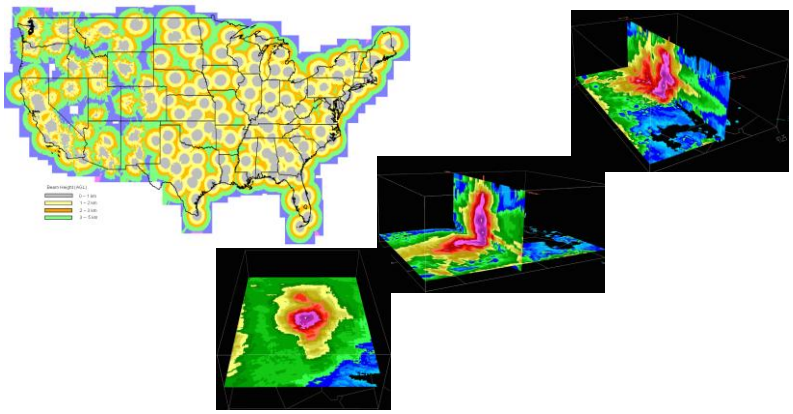
http://nmq.ou.edu/qvs-2012.html

RUA – Rapidly Updating Analysis

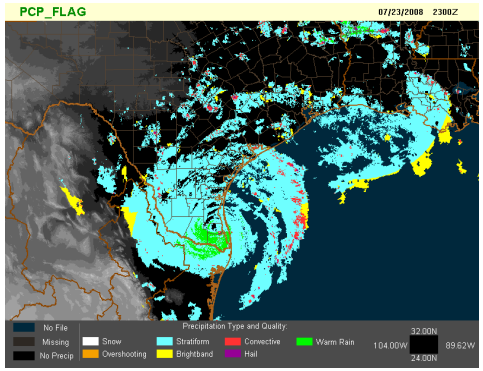
What is MRMS?

- **MRMS** = Multiple-Radar / Multiple-Sensor

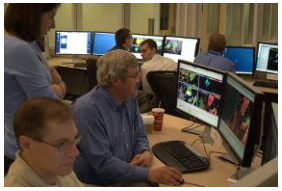
- **Multi-Radar:** Exploits the overlapping coverage of the WSR-88D network and the Level-II real-time data feeds to build a seamless rapidly-updating high-resolution three-dimensional cube of radar data.



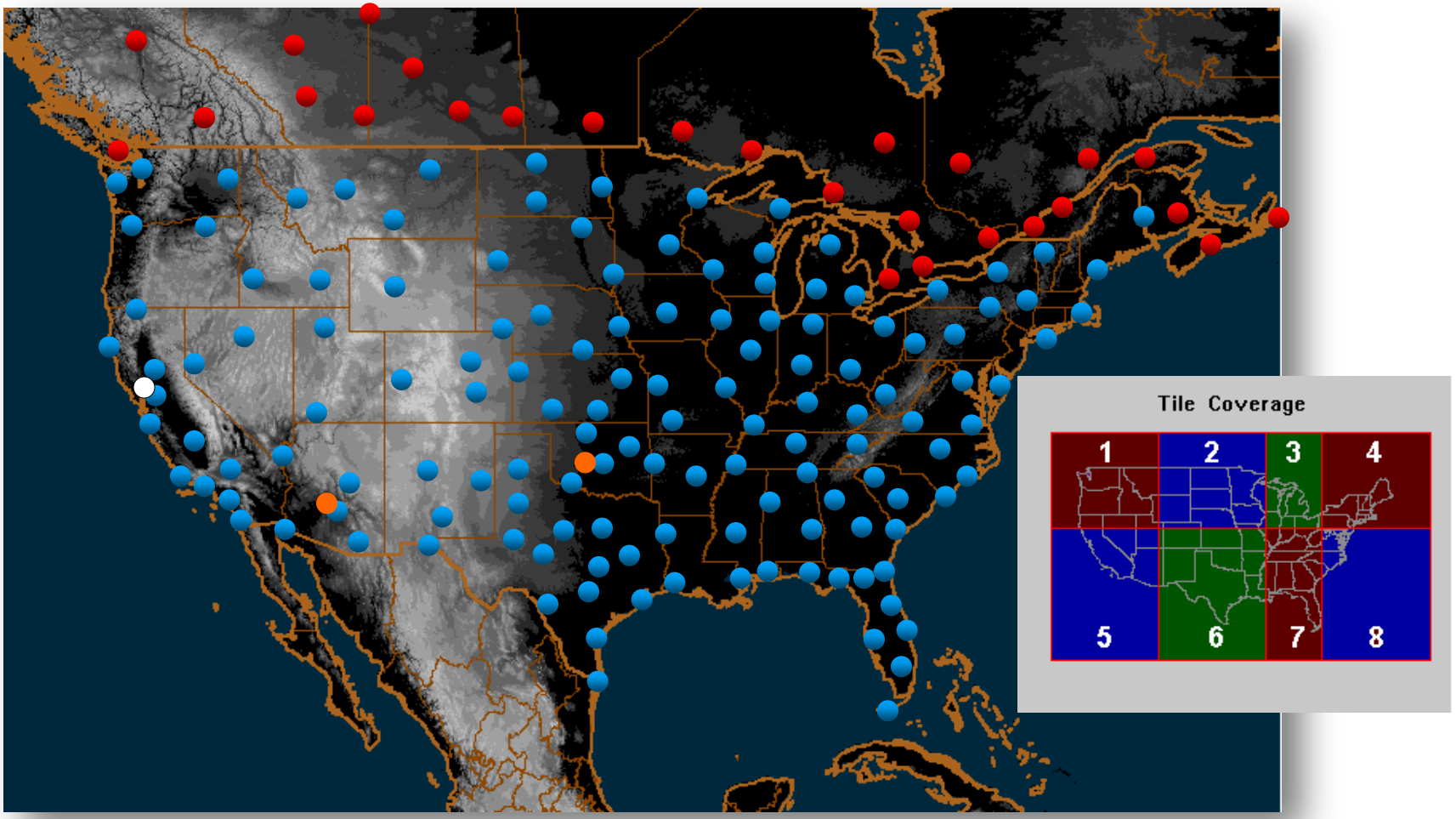
- **Multi-Sensor:** Objectively blends data from the multiple-radar 3D cubes with surface, upper air, lightning, satellite, rain gauges, and NWP environmental data, to produce highly-robust decision assistance products.



- Improvements demonstrated in QPE, severe weather diagnosis, warning decision efficiency, NWP, etc.



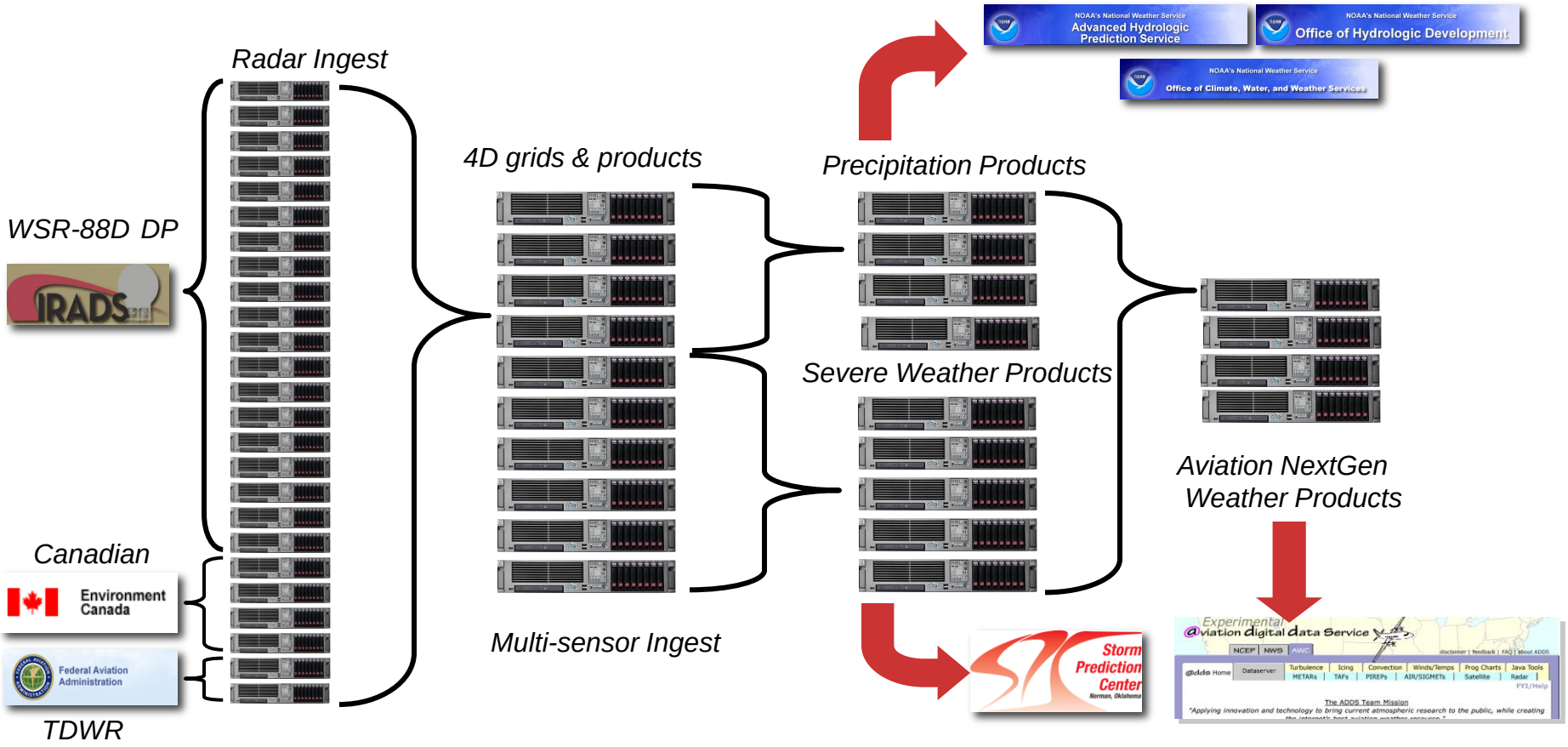
MRMS/Q2 Domain



● ~140 WSR-88D ● 31 Canadian ● 24 TDWR ○ 1 TV station radar

MRMS/Q2

Mosaic and Product Creation



Products are disseminated in NetCDF, binary, AWIPS, N-AWIPS, GIS, GRP2, and HRAP formats using the LDM protocol

Advantages of MRMS

Integrate multiple-radar and multiple-sensor information

- No longer single-radar specific.
- **More accuracy** in detection and diagnosis (better sampling - more "eyes" looking at storms).

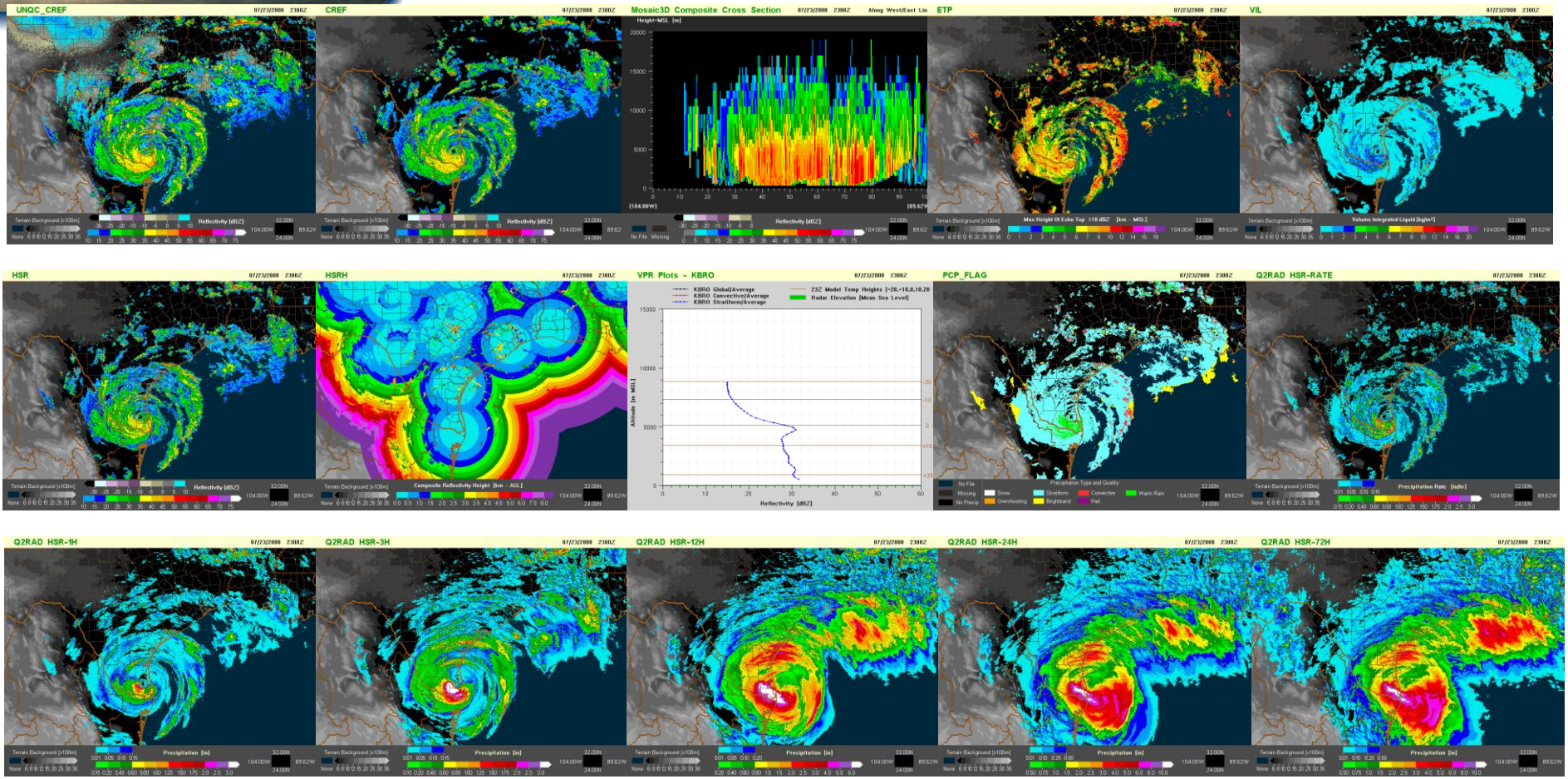
Rapid-update capability

- Uses virtual volume scan concept.
- **Better lead time** (no more waiting until end of volume scan for guidance).

Automatically fill in outage gaps by other sensors

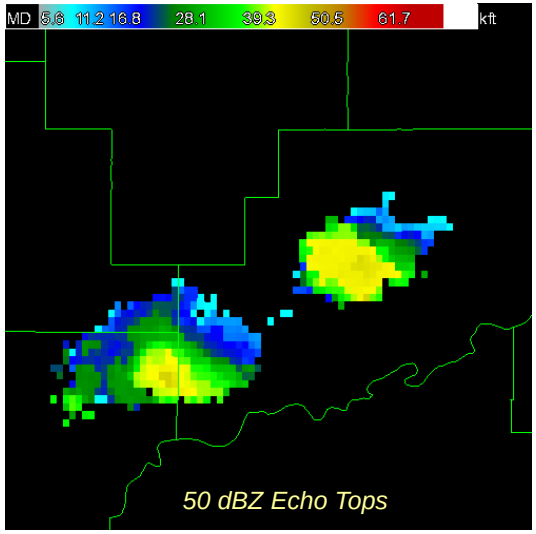
- Provides **better continuity of operations**.

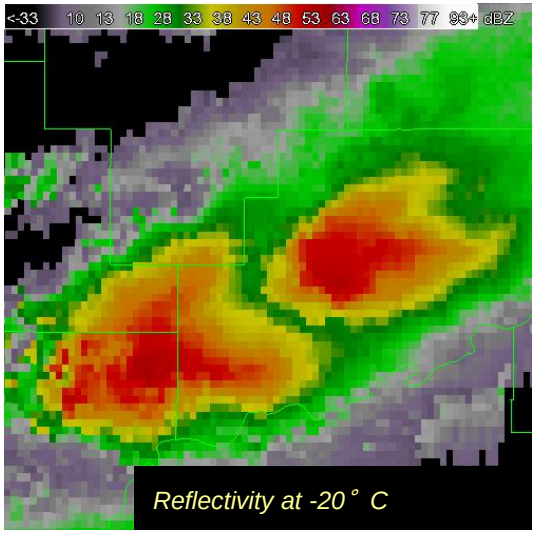
MRMS Reflectivity, Precipitation & Diagnostic Grids

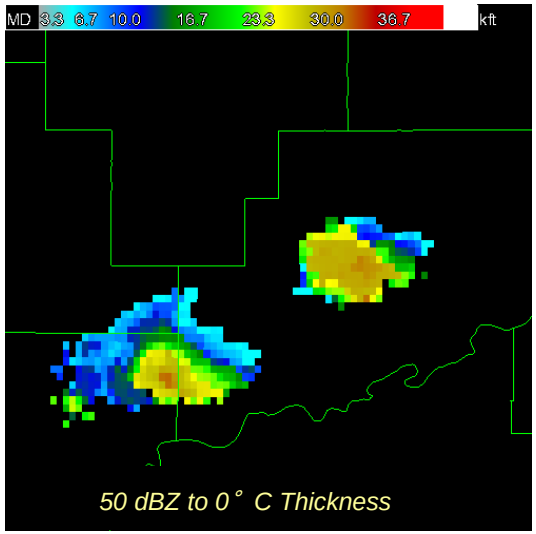


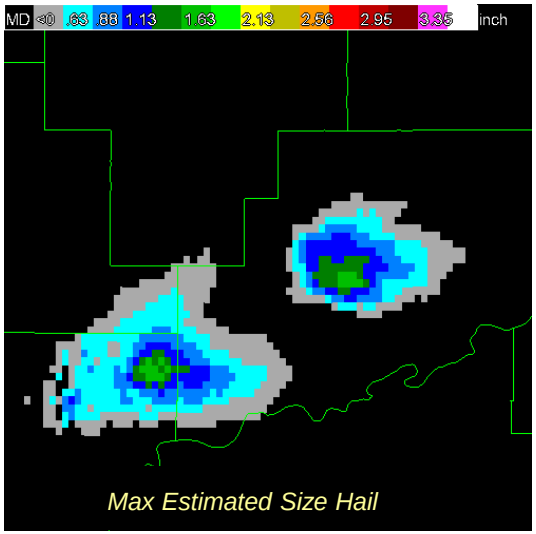
NSSL produces and disseminates a suite of **40+** high resolution product grids over North America **(1-km, 2 to 5 minutes)** for use in model data assimilation, severe weather, aviation product development and hydrometeorology.

Multi-sensor reflectivity products



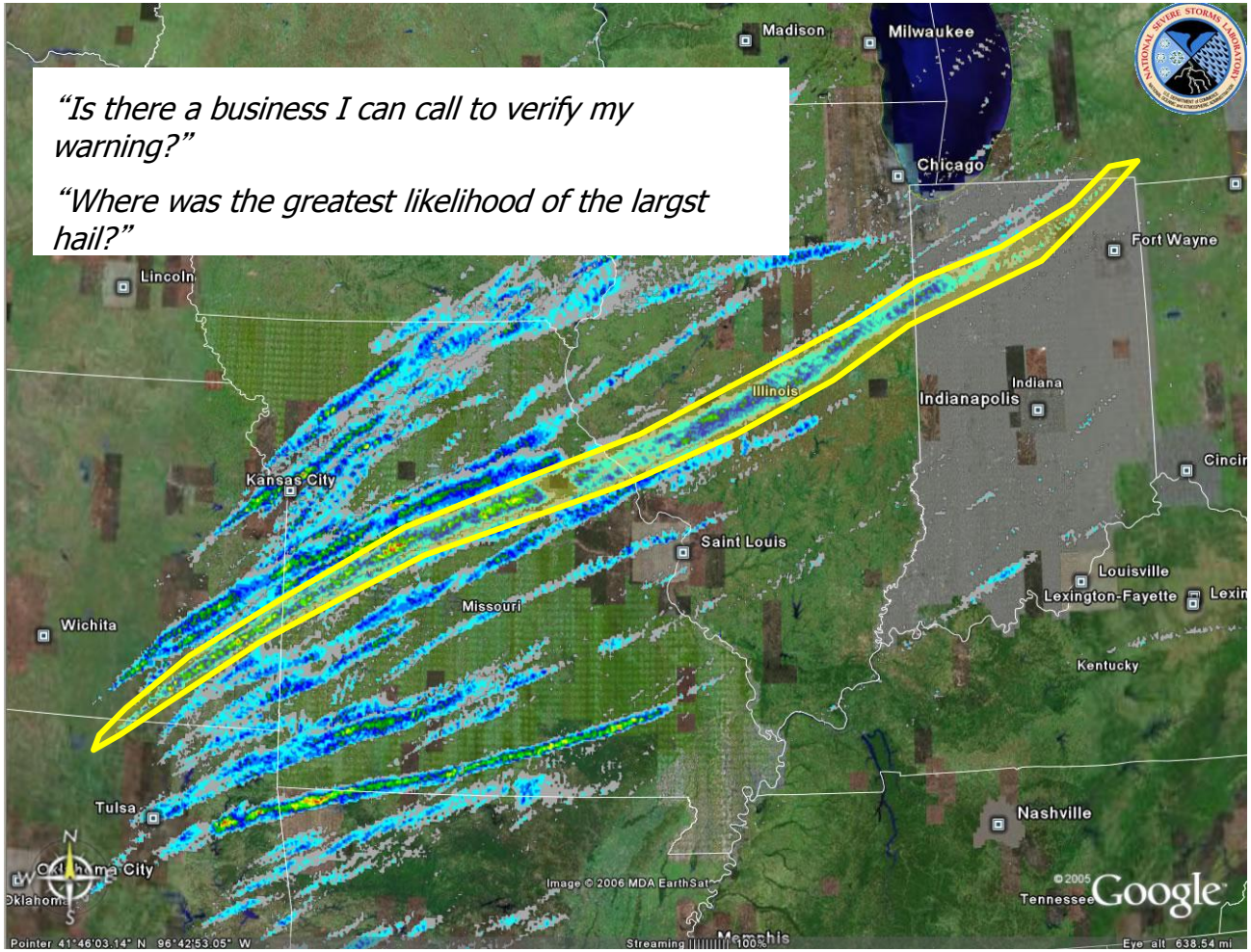






- *Reflectivity At Lowest Altitude*
- *Maximum Vertical Reflectivity (CR)*
- *Echo Tops (18, 30, 50 dBZ)*
- *Isothermal Reflectivity (0° C, -10° C, -20° C)*
- *Isothermal Reflectivity Thickness*
- *Layer Reflectivity (Average, Maximum, Integrated)*
- *VIL, VIL Density*
- *POSH, MESH*

MRMS Hail Swaths



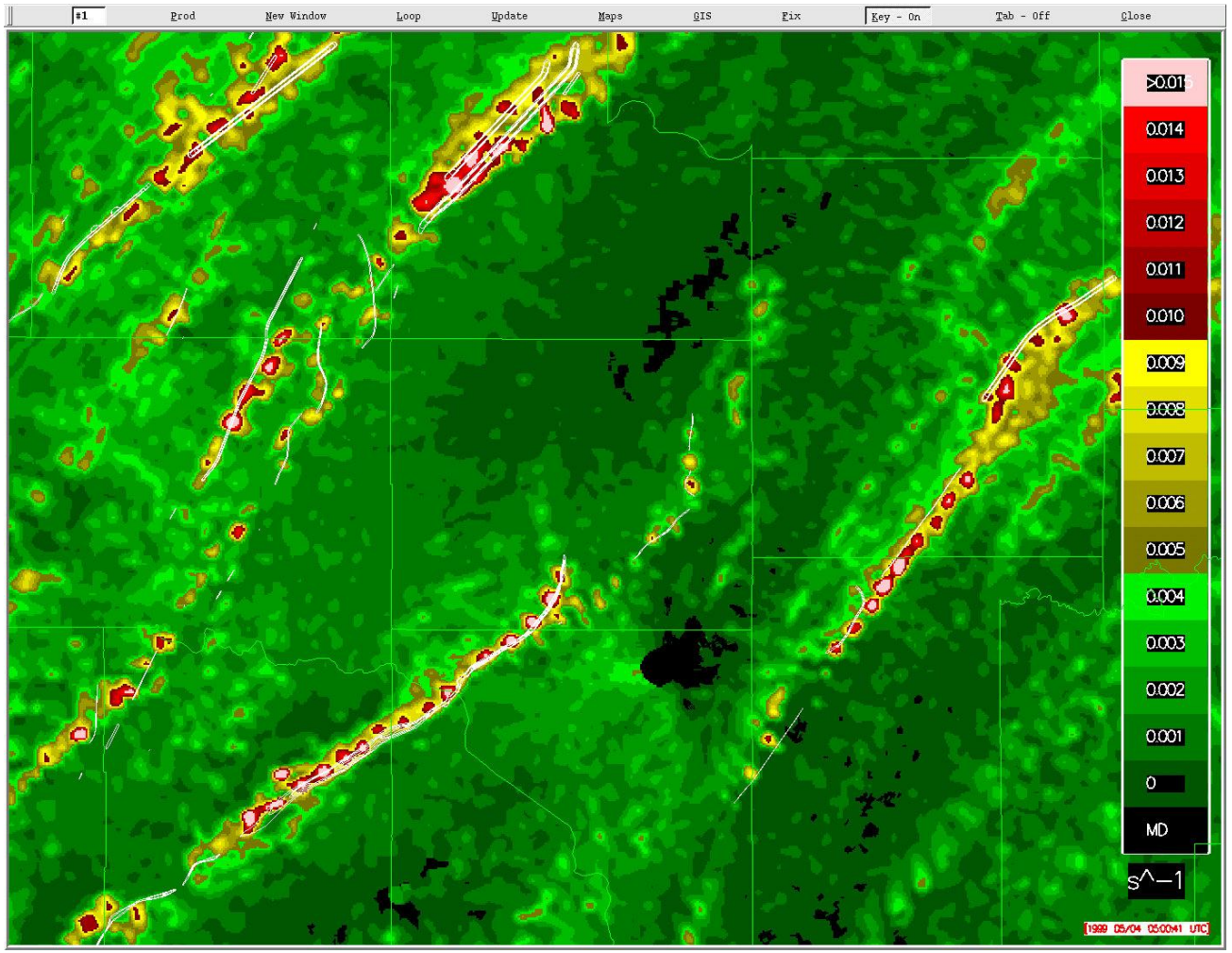
March 12-13 2006 Outbreak

Kansas
Missouri
Illinois
Indiana

MRMS
Hail Swaths

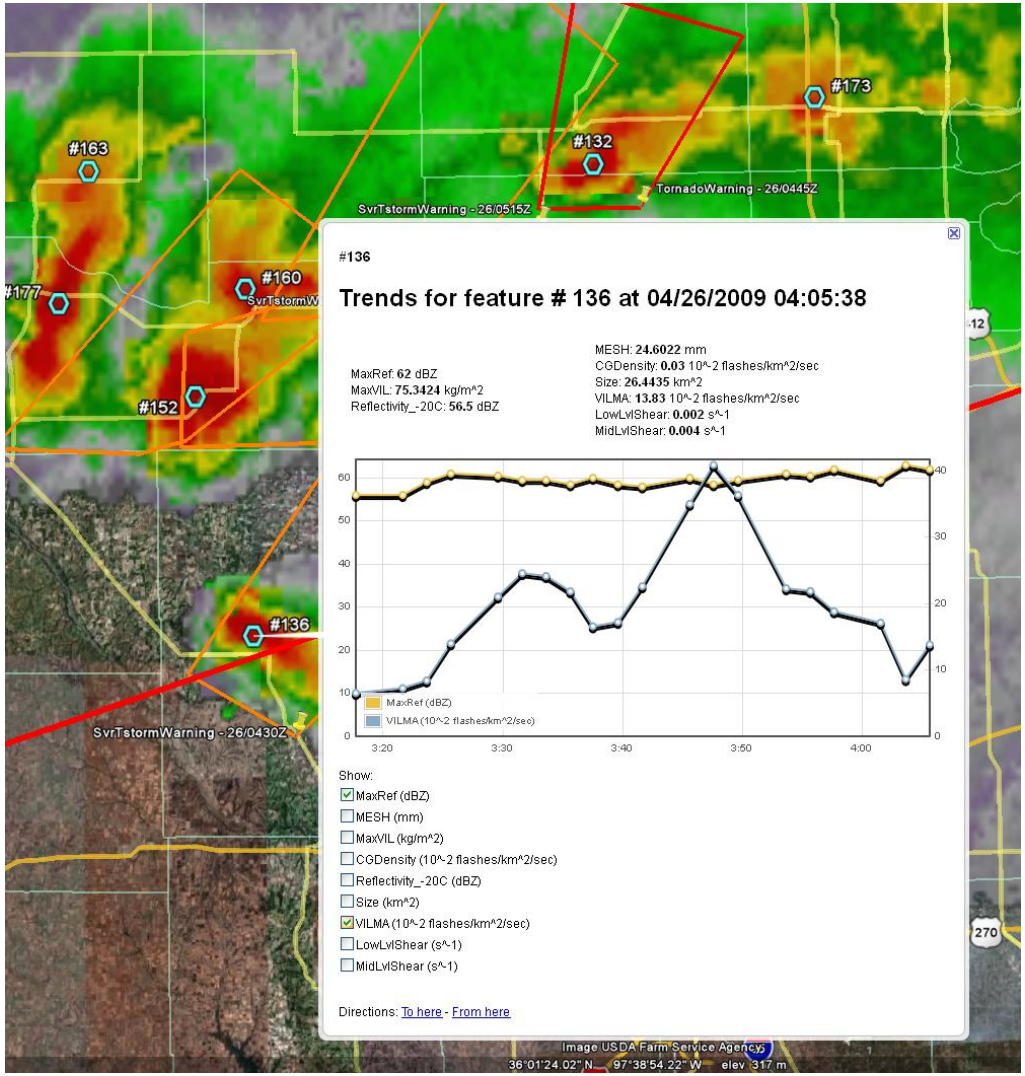
Note "Six-State Supercell"!

Multiple-Radar "Rotation Tracks"



Cluster tracking and trends

- Based on “K-Means” image processing technique
- Identifies areas of interested based on any MRMS field (e.g., Isothermal Reflectivity at -10° C, Satellite IR temperatures)
- Multi-parameter trends available in Google Earth



Forecast and Severe Weather Products

	Product	Candidates?	System or Publisher	Comments	Product Resolution/ Area	Update Frequency (minutes)	Product Format	Min/Max Size (bytes)	Short Title	Abstract	Keywords	Coordinate Reference System	Spatial Resolution	Lat/Lon Bounds NW	Lat/Lon Bounds SE	Data History (temporal exent)	Responsible Party
Forecast Products																	
	30-min Forecast Composite Reflectivity Mosaic 0-60k ft	Yes	NSSL W2	Exists: venus MergedReflectivityQCComposite_030min	1x1km/ W2 CONUS	5	Ncdf	500K/5M	CREF_30MIN_FCST	Forecast Composite Reflectivity in 30 minutes	composite reflectivity, nowcast	EPSG 3786	0.01x0.01 deg (1x1km)	51.0, -127.0	21.0, -65.0	24-hrs	NSSL
	30-min Forecast VIL	Yes	NSSL W2	Exists: venus VIL_030min	1x1km/ W2 CONUS	5	Ncdf	10K/200K	VIL_30MIN_FCST	Forecast Vertically Integrated Liquid in 30 minutes	VIL, nowcast	EPSG 3786	0.01x0.01 deg (1x1km)	51.0, -127.0	21.0, -65.0	24-hrs	NSSL
Lightning Product																	
	Lightning Density	Yes	NSSL W2	Exists: nmqwd16 LightningDensity/030_min	1x1km/ W2 CONUS	5	Ncdf	10K/5M	LTG_DENSITY	Density of cloud-to-ground lightning	lightning	EPSG 3786	0.01x0.01 deg (1x1km)	51.0, -127.0	21.0, -65.0	24-hrs	NSSL
	Lightning Probability 0-30min	Yes	NSSL W2	Exists: mars LightningProbability30min /scale_1	1x1km/ W2 CONUS	~15	Ncdf	10K/5M	LTG_30MIN_PROB	Probability (%) of cloud-to-ground lightning in next 30	lightning, nowcast	EPSG 3786	0.01x0.01 deg (1x1km)	51.0, -127.0	21.0, -65.0	24-hrs	NSSL
Severe Weather Products																	
	Azimuth Shear 0-2km AGL	Yes	NSSL W2	Exists: nmqwd19 AzShear 0-2km AGL	.5 km/ W2 CONUS	2	Ncdf	500K/10M	AZ_SHEAR_2KM	Maximum azimuthal shear (rotation) in the 0-2 km AGL	storm circulation	EPSG 3786	0.005x0.005 deg (0.5x0.5km)	51.0, -127.0	21.0, -65.0	24-hrs	NSSL
	Azimuth Shear 3-6km AGL	Yes	NSSL W2	Exists: nmqwd19 AzShear 3-6km AGL	.5 km/ W2 CONUS	2	Ncdf	500K/10M	AZ_SHEAR_6KM	Maximum azimuthal shear (rotation) in the 3-6 km AGL	storm circulation	EPSG 3786	0.005x0.005 deg (0.5x0.5km)	51.0, -127.0	21.0, -65.0	24-hrs	NSSL
	Azimuth Shear 0-2km AGL 30-minute Max	Yes	NSSL W2	Exists: mars RotationTrack30Min	.5 km/ W2 CONUS	2	Ncdf	500K/10M	AZ_SHEAR_2KM_30MIN_MAX	30-minute track of low-altitude (0-2 km AGL) rotation	storm circulation, accumulation	EPSG 3786	0.005x0.005 deg (0.5x0.5km)	51.0, -127.0	21.0, -65.0	24-hrs	NSSL
	Azimuth Shear 3-6km AGL 30-minute Max	Yes	NSSL W2	Exists: mars RotationTrackML30Min	.5 km/ W2 CONUS	2	Ncdf	500K/10M	AZ_SHEAR_6KM_30MIN_MAX	30-minute track of mid-altitude (3-6 km AGL) rotation	storm circulation, accumulation	EPSG 3786	0.005x0.005 deg (0.5x0.5km)	51.0, -127.0	21.0, -65.0	24-hrs	NSSL
	Severe Hail Index	Yes	NSSL HMRG	Exists: 3D Mosaic nmqxrt-2 – 5 (tiles)	1x1km/ CONUS	5	Ncdf	.5K/10K	SHI	The primary predictor variable for severe-size hail	Severe Hail	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	Prop of Severe Hail	Yes	NSSL HMRG	Exists: 3D Mosaic nmqxrt-2 – 5 (tiles)	1x1km/ CONUS	5	Ncdf	.5K/2K	POSH	Probability (%) of severe-size hail (diameter >=19mm).	Severe Hail	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	MESH 30-min Max Swath (HailSwath)	Yes	NSSL W2	Exists: juno MESH_MAX_30min	1x1km/ W2 CONUS	5	Ncdf	10K/100K	HAILSWATH_30MIN			EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	Maximum Expected Hai Size (MEHS)	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	1K/20K	MEHS	Maximum expected hail size (mm). Witt, A., M. D. Eilts, G. J.	Hail size	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL

Base Reflectivity Mosaic Products

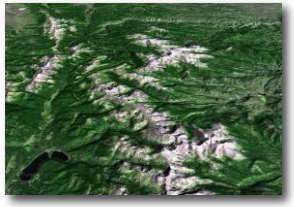
	Product	Candidates?	System or Publisher	Comments	Product Resolution/ Area	Update Frequency (minutes)	Product Format	Min/Max Size (bytes)	Short Title	Abstract	Keywords	Coordinate Reference System	Spatial Resolution	Lat/Lon Bounds NW	Lat/Lon Bounds SE	Data History (temporal exent)	Responsible Party
Reflectivity Mosaics																	
	Mosaic Base Reflectivity (optimal method)	Yes	NSSL W2+HMRG	Exists: nmqwd25 w2merger + converter	1x1km/ CONUS	5	Ncdf	500K/5M	BASE_REFL	A 2-D mosaic of base reflectivity fields (i.e.,	mosaic, base reflectivity	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	Composite Reflectivity Mosaic 0-60k ft. (optimal method)	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	500K/5M	COMP_REFL	A 2-D mosaic of the composite reflectivity (i.e., the maximum	mosaic, composite reflectivity	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	Height of Composite Reflectivity Mosaic 0-60k ft. (optimal method)	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	500K/5M	COMP_REFL_HGT	Height associated with the composite reflectivity at each given point.	composite reflectivity, height	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	UnQc'd Composite Reflectivity Mosaic 0-60k ft. (max ref)	Yes	NSSL W2+HMRG	Exists: nmqxrt-11 w2merger + converter	1x1km/ CONUS	5	Ncdf	500K/5M	UNQC_COMP_REFL	Same as the "Composite Reflectivity Mosaic", but	mosaic, composite reflectivity	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	Composite Reflectivity Mosaic 0-60k ft. (max ref)	Yes	NSSL HMRG	Exists: nmqwd25 w2merger + converter	1x1km/ CONUS	5	Ncdf	500K/5M	COMP_REFL_MAX	Same as the "Composite Reflectivity Mosaic", but only	mosaic, composite reflectivity	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	VIL based 3D Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	10K/200K	VIL	vertically integrated liquid water content (kg/m^2).	vertically integrated liquid-water	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	VIL Density based on 3D Mosaic	Yes	NSS HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	10K/200K	VIL_DENSITY	VIL density is the VIL normalized by the storm	vertically integrated liquid-water	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	Echo Top 18dBZ Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/1M	ECHOTOP-18DBZ	Top of the 18dBZ or higher echoes. Usually high echo	echo top, storm	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	Storm Top 30dBZ Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/1M	STRMTOP-30DBZ	Top of the 30dBZ or higher echoes. Usually high echo	echo top, storm	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	Layer Composite Reflectivity Mosaic 0-24kft (low altitude)	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	LAYER_CREF_LOW	Same as the "Composite Reflectivity Mosaic", but only	layer composite reflectivity	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	Layer Composite Reflectivity Mosaic 24-60 kft (highest altitude)	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	LAYER_CREF_HIGH	Same as the "Composite Reflectivity Mosaic", but only for a vertical depth of 24-60k	layer composite reflectivity	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	Layer Composite Reflectivity Mosaic 33-60 kft (super high altitude)	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	LAYER_CREF_SUPER	Same as the "Composite Reflectivity Mosaic", but only for a vertical depth of 33-60k	layer composite reflectivity	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	Hybrid Scan Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	HYBRID_SCAN_REFL	Reflectivities from the lowest and un-blocked radar beams.	hybrid scan reflectivity, radar QPE	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	VPR 'corrected' Hybrid Scan Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqwd36 SHSR Mosaic	1x1km/ CONUS	5	Ncdf	100K/5M	HYBRID_SCAN_REFL_VPR_CORRECTED	Reflectivities from the lowest and un-blocked radar beams,	vertical profile of reflectivity (VPR), radar QPE, bright band	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	Height of Hybrid Scan Reflectivity	Yes	NSSL HMRG	Exists: nmqwd36 SHSR Mosaic	1x1km/ CONUS	5	Ncdf	500K/15M	HYBRID_SCAN_REFL_HGT	Height associated with the hybrid scan reflectivity	hybrid scan reflectivity, radar QPE	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL

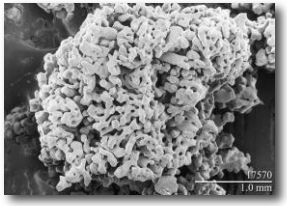
Flight Level Reflectivity Mosaics

Product	Candidates?	System or Publisher	Comments	Product Resolution/ Area	Update Frequency (minutes)	Product Format	Min/Max Size (bytes)	Short Title	Abstract	Keywords	Coordinate Reference System	Spatial Resolution	Lat/Lon Bounds NW	Lat/Lon Bounds SE	Data History (temporal exent)	Responsible Party
500m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_00500MSL	horizontal cross section of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
750m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_00750MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
1000m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_01000MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
1250m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_01250MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
1500m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_01500MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
1750m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_01750MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
2000m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_02000MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
2250m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_02250MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
2500m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_02500MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
2750m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_02750MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
3000m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_03000MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
3500m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_03500MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
4000m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_04000MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
4500m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_04500MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
5000m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_05000MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
5500m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_05500MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
6000m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_06000MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
6500m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_06500MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
7000m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_07000MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
7500m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_07500MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
8000m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_08000MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
8500m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_08500MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
9000m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_09000MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
10000m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_10000MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
11000m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_11000MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
12000m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_12000MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
13000m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_13000MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
14000m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_14000MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
15000m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_15000MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
16000m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_16000MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
18000m Flight Level Reflectivity Mosaic	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	100K/5M	MOSAIC_REFL_18000MSL	horizontal distribution of reflectivity on a constant	3-D reflectivity, national radar mosaic	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL

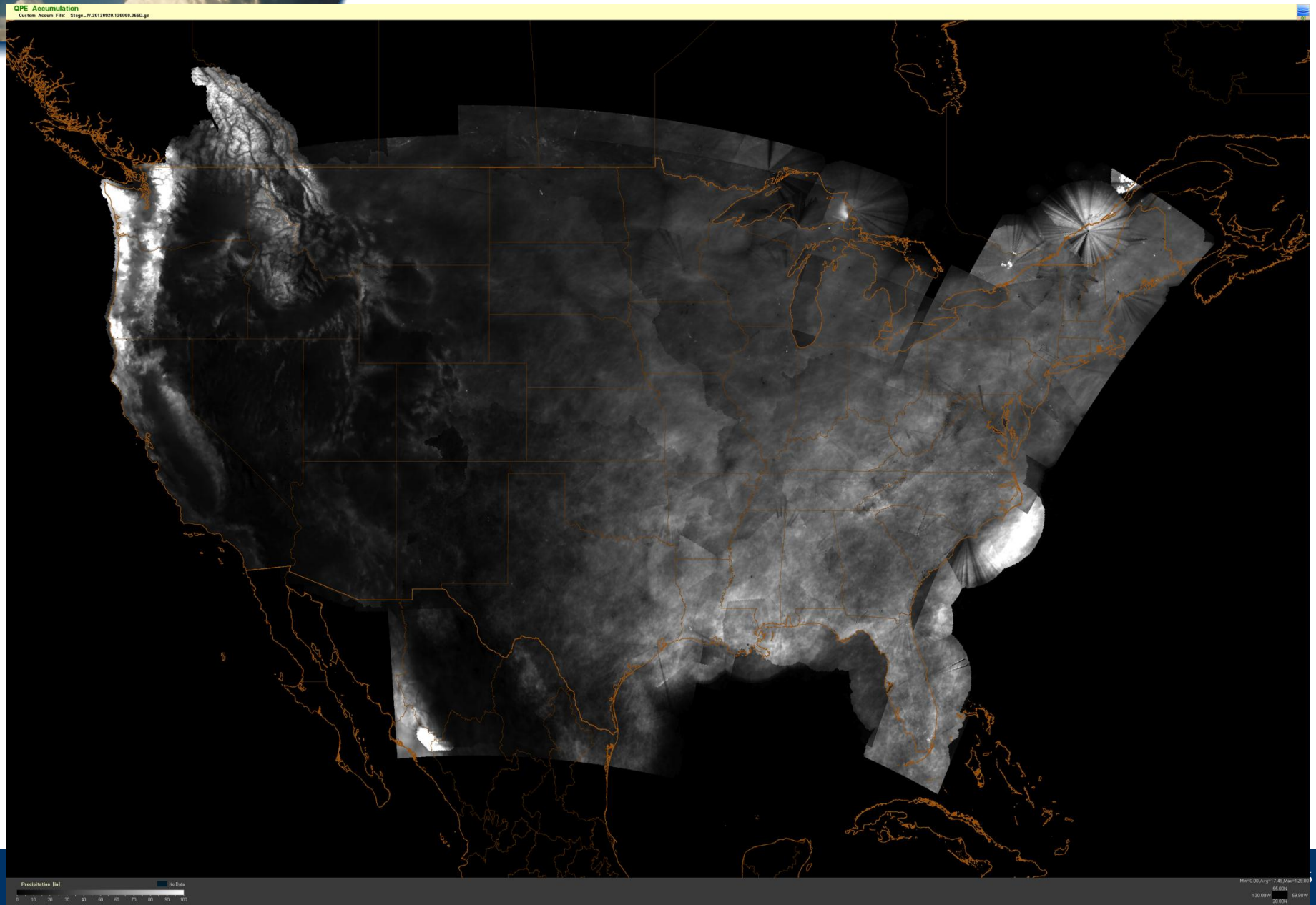
QPE….

The accurate observation and prediction of precipitation phase and rate is the greatest challenge in atmospheric science and operations.





Stage 4 1Y Accum.



Q2 Vision

"While tremendous progress has been made in the last quarter-century in many areas of QPE and VSTQPF, ***significant gaps continue to exist in both knowledge and capabilities*** *that are necessary to produce* ***accurate high-resolution precipitation estimates at the national scale*** *for a wide spectrum of users."*

"To meet the nation's needs for the precipitation information effectively, the authors herein propose a community-wide ***integrated approach for precipitation information that fully capitalizes on recent advances in science and technology, and leverages the wide range of expertise and experience that exists in the research and operational communities."*

ARTICLES

IMPROVING QPE AND VERY SHORT TERM QPF

An Initiative for a Community-Wide Integrated Approach

BY STEVEN V. VASILOFF, DONG-JUN SEO, KENNETH W. HOWARD, JIAN ZHANG, DAVID H. KITZMILLER, MARY G. MULLUSKY, WITOLD F. KRAJEWSKI, EDWARD A. BRANDES, ROBERT M. RABIN, DANIEL S. BERKOWITZ, HAROLD E. BROOKS, JOHN A. MCGINLEY, ROBERT J. KULIGOWSKI, AND BARBARA G. BROWN

A multisensor applications development and evaluation system at the National Severe Storms Laboratory addresses significant gaps in both our knowledge and capabilities for accurate high-resolution precipitation estimates at the national scale.

Water is a precious resource and, when excessive or in short supply, a source of many hazards. It is essential to monitor and predict water-related hazards, such as floods, droughts, debris flows, and water quality, and to determine current and future availability of water resources. Accurate quantitative precipitation estimates (QPE) and very short term quantitative precipitation forecasts (VSTQPF) provide key input to these assessments. [QPE and VSTQPF are hereafter referred to collectively as quantitative precipitation information (QPI).] To meet these needs at the national scale, accurate QPI is needed at various temporal and spatial scales for the entire United States, its territories, and immediate surrounding areas. Temporal scales range from minutes to several hours for flash flood prediction. QPI products can then be aggregated to support longer-term applications for water supply prediction. Spatial scales range from a few square kilometers or less for urban flash flood prediction,

AFFILIATIONS: VASILOFF, HOWARD, RABIN, AND BROOKS—NOAA/National Severe Storms Laboratory, Norman, Oklahoma; SEO—NOAA/NWS/Office of Hydrologic Development, Silver Spring, Maryland, and University Corporation for Atmospheric Research, Boulder, Colorado; ZHANG—Cooperative Institute for Mesoscale Meteorological Studies, University of Oklahoma, and NOAA/OAR National Severe Storms Laboratory, Norman, Oklahoma; KITZMILLER—NOAA/NWS/Office of Hydrologic Development, Silver Spring, Maryland; MULLUSKY—NOAA/NWS/Office of Climate, Water, and Weather Services, Silver Spring, Maryland; KRAJEWSKI—IIHR—The University of Iowa, Iowa City, Iowa; BRANDES AND BROWN—National Center for Atmospheric Research, Boulder, Colorado; BERKOWITZ—NOAA/WSR-88D Radar Operations Center, Norman, Oklahoma; MCGINLEY—NOAA/Earth System Research Laboratory, Boulder, Colorado; KULIGOWSKI—NOAA/National Environmental Satellite, Data, and Information Service, Camp Springs, Maryland
CORRESPONDING AUTHOR: Steven Vasiloff, NOAA/National Severe Storms Laboratory, National Weather Center, 120 David L. Boren Blvd., Norman, OK 73072
E-mail: steven.vasiloff@noaa.gov

The abstract for this article can be found in this issue, following the table of contents.

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Q2

Q2 *exists today* *as a scientific and community-based convergence towards accurate, very high-resolution* ***multi-sensor*** *precipitation estimates on a national to global scale.*

Q2 is a continuation of NSSL's departure from a radar-centric approach to precipitation estimation towards a seamless ***integration*** *of radar, satellite, model, and surface observations.*

Q2 goal is to glean the ***best practices*** *and techniques from NOAA's River Forecast Centers, Forecast Offices, Office of Hydrology, OAR labs, domestic/international organizations and universities.*

NATIONAL MOSAIC AND MULTI-SENSOR QPE (NMQ) SYSTEM

Description, Results, and Future Plans

BY JIAN ZHANG, KENNETH HOWARD, CARRIE LANGSTON, STEVE VASILOFF, BRIAN KANEY, AMI ARTHUR, SUZANNE VAN COOTEN, KEVIN KELLEHER, DAVID KITZMILLER, FENG DING, DONG-JUN SEO, ERNIE WELLS, AND CHUCK DEMPSEY

A research system integrates radar, rain gauge, satellite, and numerical weather prediction data and generates automated, seamless national 3D radar mosaic and multisensor quantitative precipitation estimates at high temporal and spatial resolution.

The deployment of the U.S. Weather Surveillance Radar-1988 Doppler (WSR-88D) network (Crum and Alberty 1993; www.roc.noaa.gov/) has provided meteorologists with critical information toward the issuance of warnings for tornadoes, severe storms, and flash floods. In the early years, the users were able to access only two-dimensional (2D) imagery products from single radar or multiradar mosaic instead of the full 3D base-level data in real time because of limited bandwidth for transmitting data. The advent of Internet-2 and effective compression techniques made it possible to transmit base-level radar data from the WSR-88D network economically and in real time, as demonstrated by the Collaborative Radar Acquisition Field Test (CRAFT) Project (Droegemeier et al. 2002; Kelleher et al. 2007). In 2003, the U.S. National Weather Service (NWS) implemented the communication infrastructure that facilitated the central collection and distribution of base-level data in real time from more than 140 WSR-88D sites to several centralized hubs (Crum et al. 2003a,b; www.roc.noaa.gov/NWS_Level_2/AMS.asp). Now the real-time data are available to users from government agencies, universities, and private industries. The success of the project opened many new opportunities for multiradar and multisensor applications in meteorology, aviation, and hydrology. For instance, free access to the volume scan base-level data allows users to build 3D and 4D multiradar mosaics on a regional to national scale (e.g., Zhang et al. 2005; Lakshmanan et al. 2006; Langston et al. 2007), providing more complete depictions and rendering of storm structure than previous 2D products. Further, the radar mosaic grid is easily combined with information from other data sources such as satellite, gridded model analyses,

AFFILIATIONS: ZHANG, HOWARD, VASILOFF, VAN COOTEN, AND KELLEHER—NOAA/OAR/NSSL, Norman, Oklahoma; LANGSTON, KANEY, AND ARTHUR—CIMMS/University of Oklahoma, Norman, Oklahoma; KITZMILLER, DING, AND SEO—NOAA/NWS/OHD, Silver Spring, Maryland; WELLS—NOAA/NWS/OCWWS, Silver Spring, Maryland; DEMPSEY—Salt River Project, Tempe, Arizona
CORRESPONDING AUTHOR: Jian Zhang, NOAA/National Severe Storms Laboratory, 120 David L. Boren Blvd., Norman, OK 73072
E-mail: jian.zhang@noaa.gov

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Q2 Philosophy

Focused on the flash flood scale - high resolution in both time and space – allows aggregation to larger scales

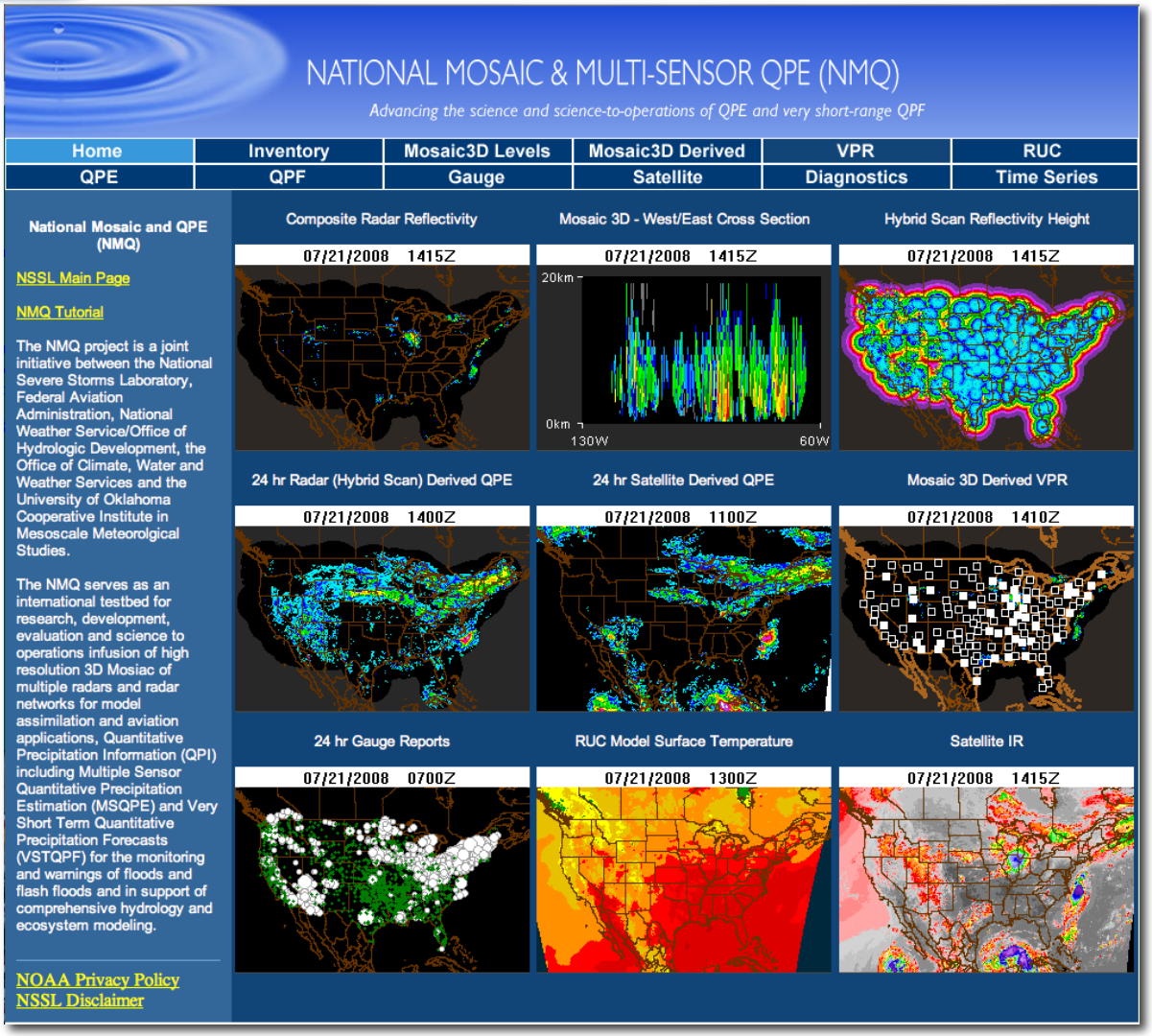
Real-time (means real world) - Q2 R&D concepts and techniques are implemented in a 'real time' system - MRMS

Operations centric - R&D focused on operational challenges and needs for critical decision support.

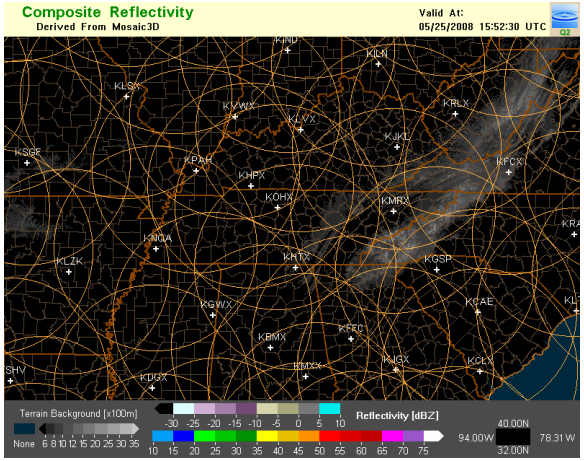
Flexible and modular to facilitate rapid R2O and advances in computational technology and scientific techniques.

Q2

Real time platform to develop, test, and assess advance techniques in quality control, data integration and precipitation estimation and short term forecasting.



Q2 Process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KOHX
KMRX
KNQA
KRA
KLZK
KHTX
KGSP
KGWX
KCAE
KEVX
KBMX
KFFC
KJGX
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KDGX
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Reflectivity [dBZ]
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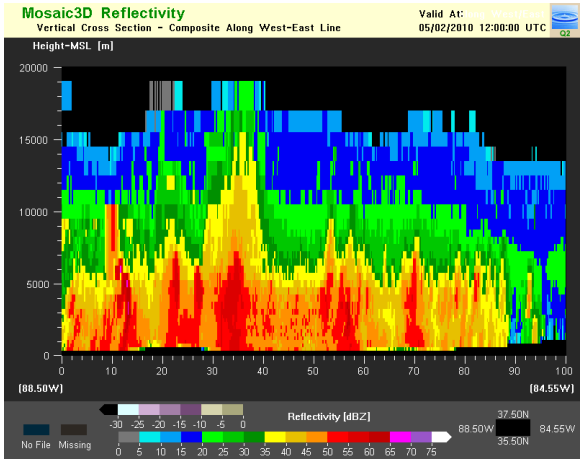
94.00W
78.31W
32.00N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Vertical Cross Section - Composite Along West-East Line
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(84.55W)
Reflectivity [dBZ]
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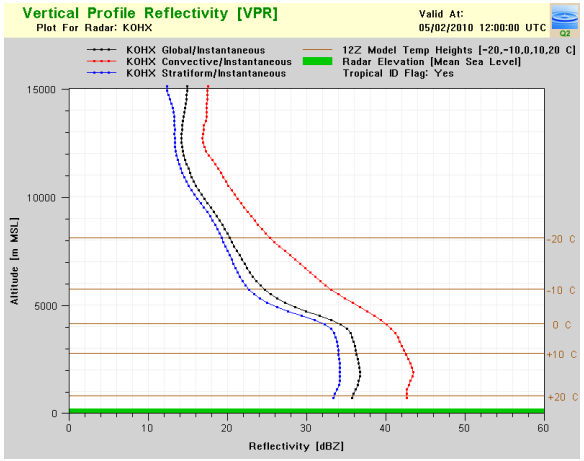
88.50W
84.55W
35.50N
No File
Missing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Plot For Radar: KOHX
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05/02/2010 12:00:00 UTC
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KOHX Convective/Instantaneous
KOHX Stratiform/Instantaneous
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Radar Elevation [Mean Sea Level]
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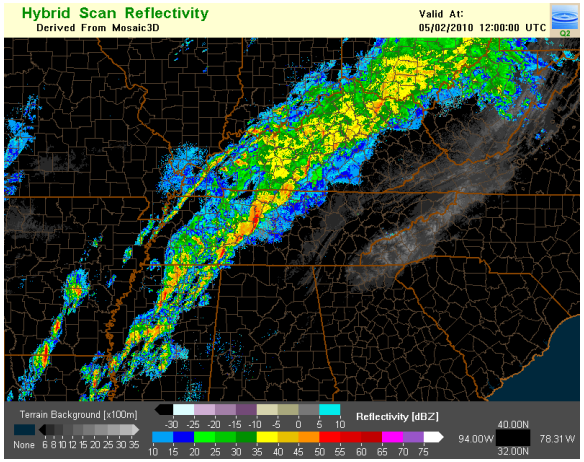
+10 C
+20 C
Reflectivity [dBZ]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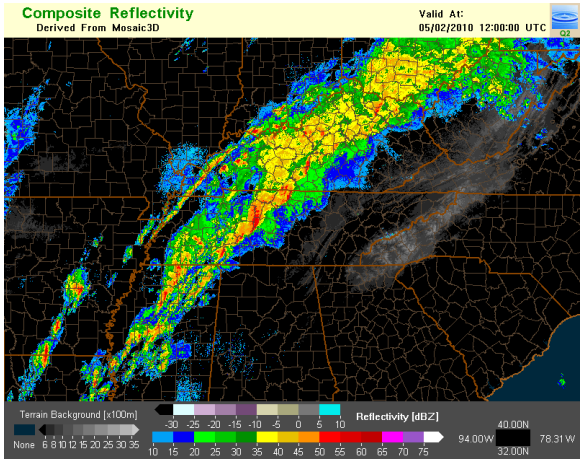
Composite Reflectivity
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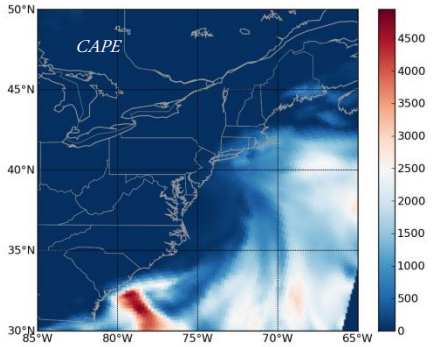
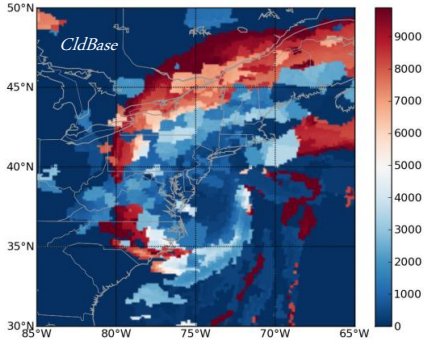
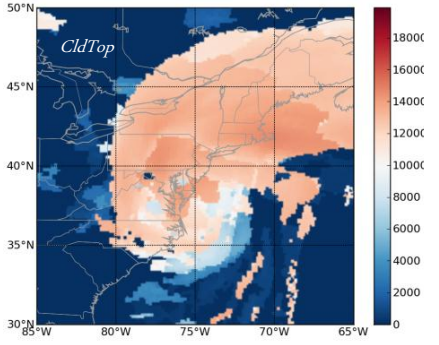
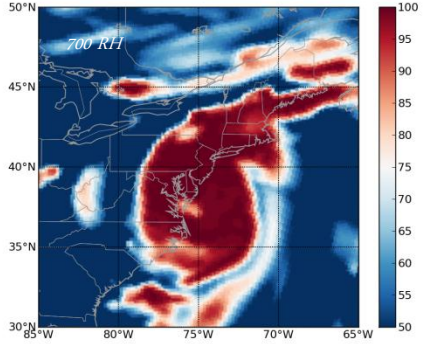
78.31W
32.00N

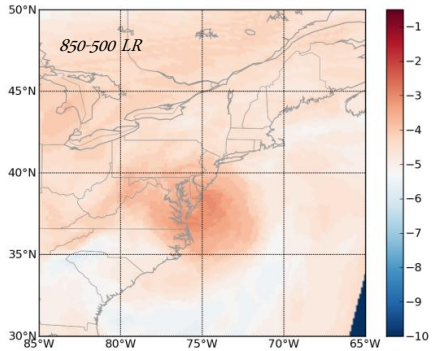
Atmospheric Environmental Fields

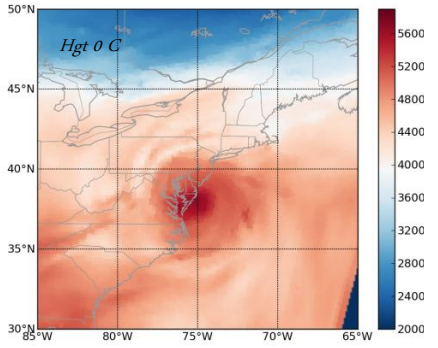


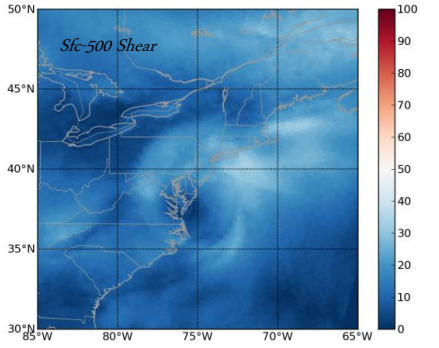


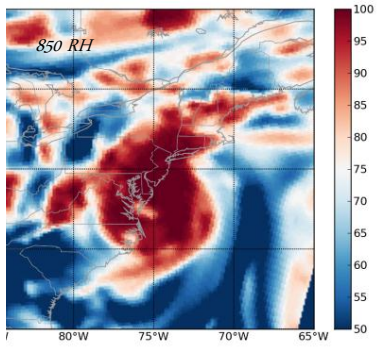


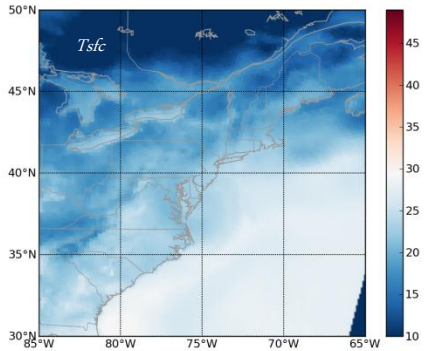


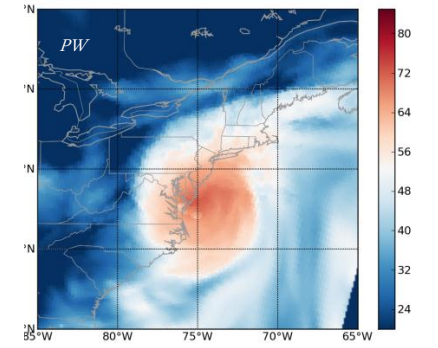


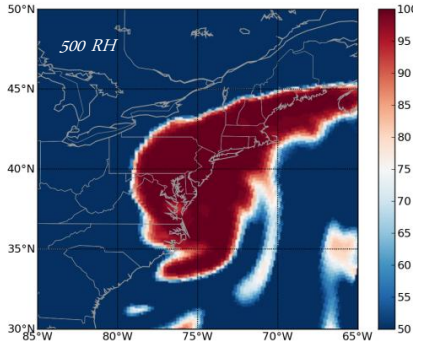


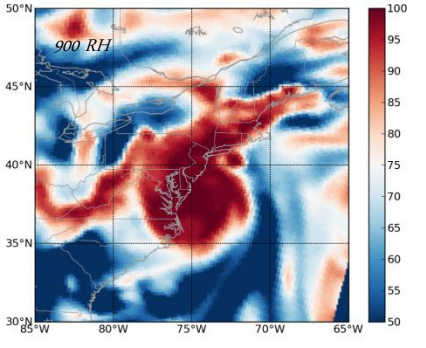




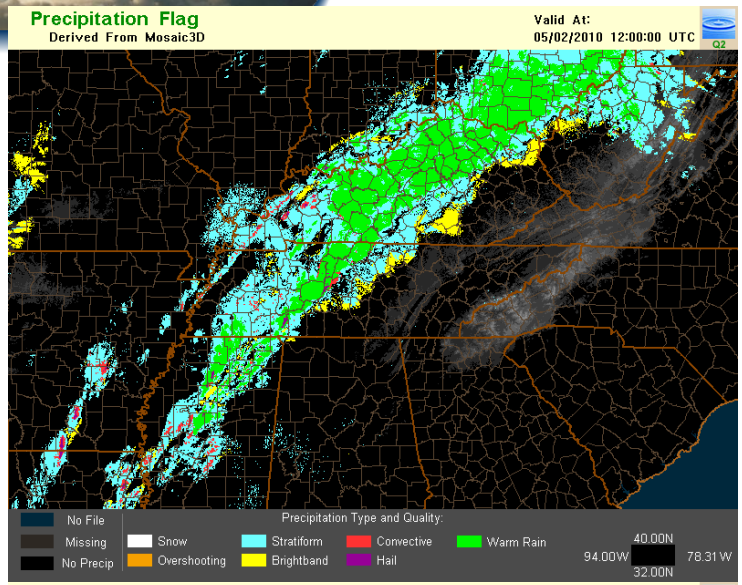


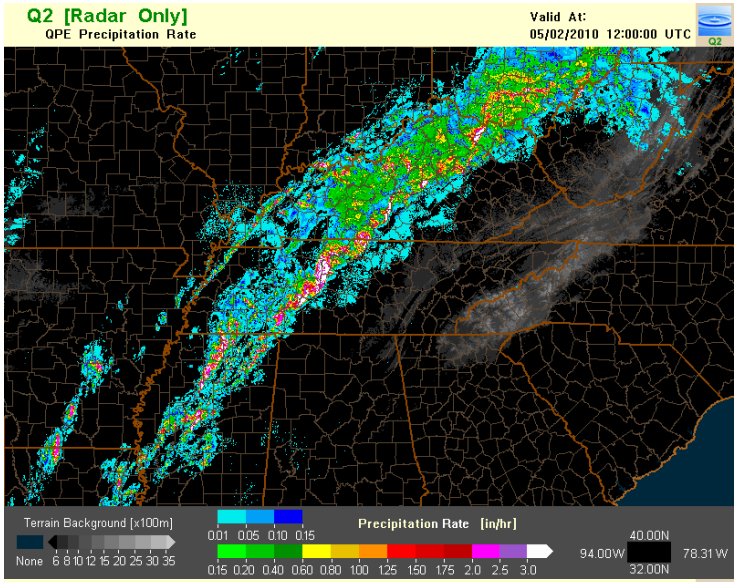


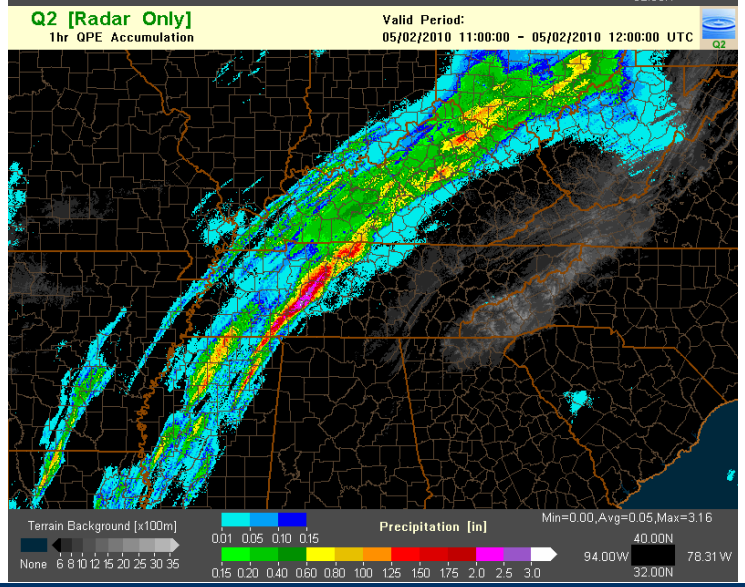


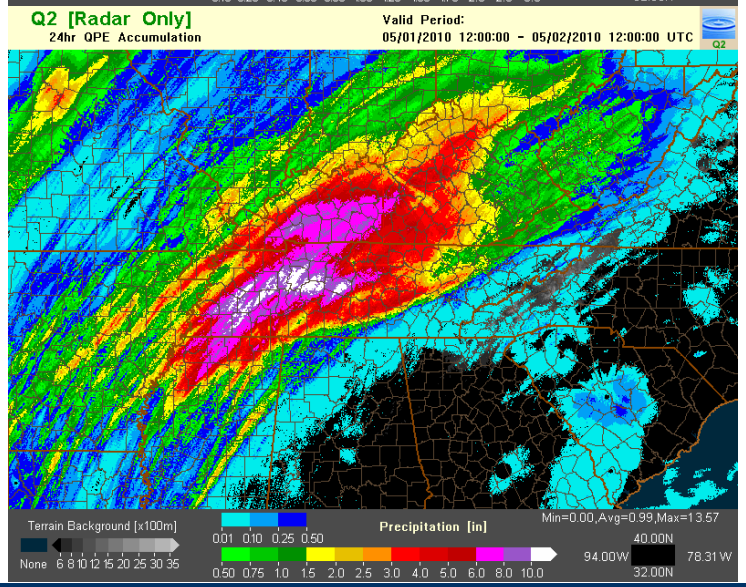


Q2 Process

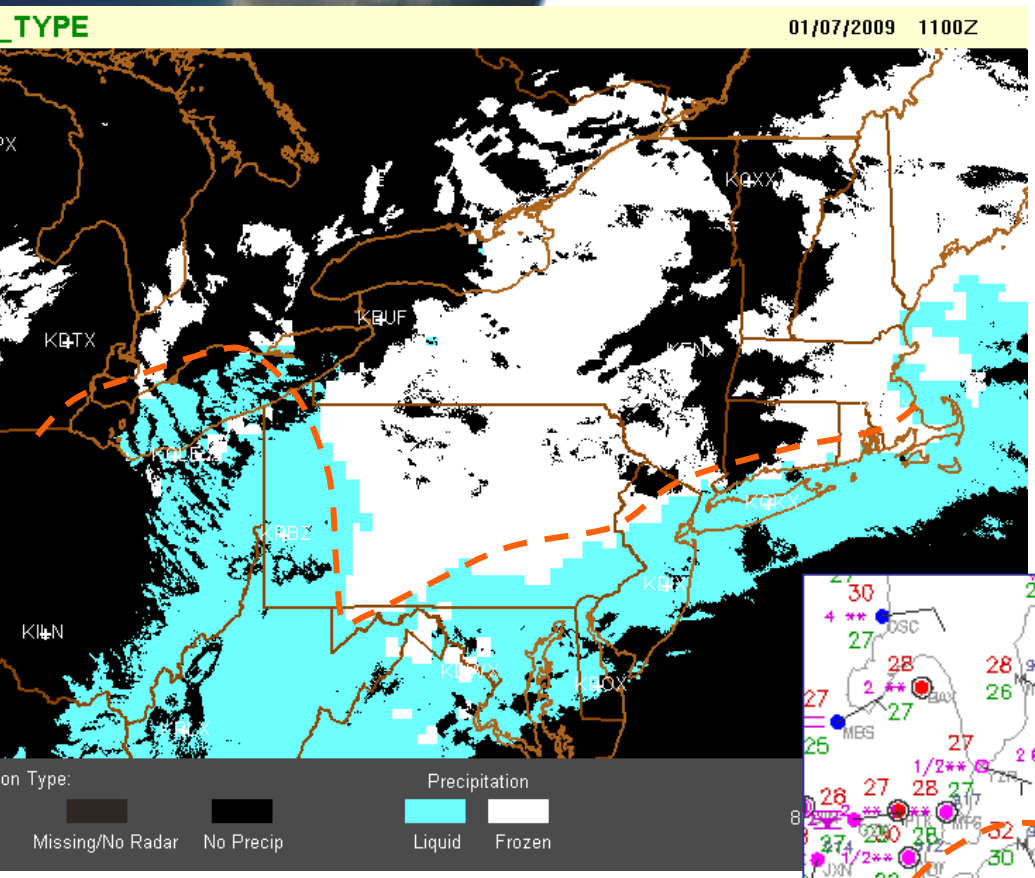

Precipitation Flag
Derived From Mosaic3D
Valid At:
05/02/2010 12:00:00 UTC
Q2
No File
Missing
No Precip
Precipitation Type and Quality:
Snow
Overshooting
Stratiform
Brightband
Convective
Hail
Warm Rain
40.00N
94.00W
78.31 W
32.00N

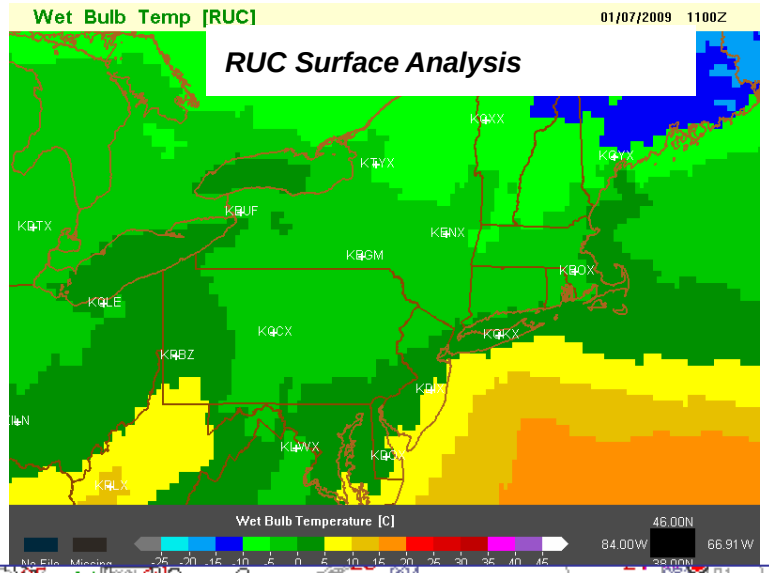

Q2 [Radar Only]
QPE Precipitation Rate
Valid At:
05/02/2010 12:00:00 UTC
Q2
Terrain Background [x100m]
None 6 8 10 12 15 20 25 30 35
Precipitation Rate [in/hr]
0.01 0.05 0.10 0.15
0.15 0.20 0.40 0.60 0.80 1.00 1.25 1.50 1.75 2.0 2.5 3.0
40.00N
94.00W
78.31 W
32.00N

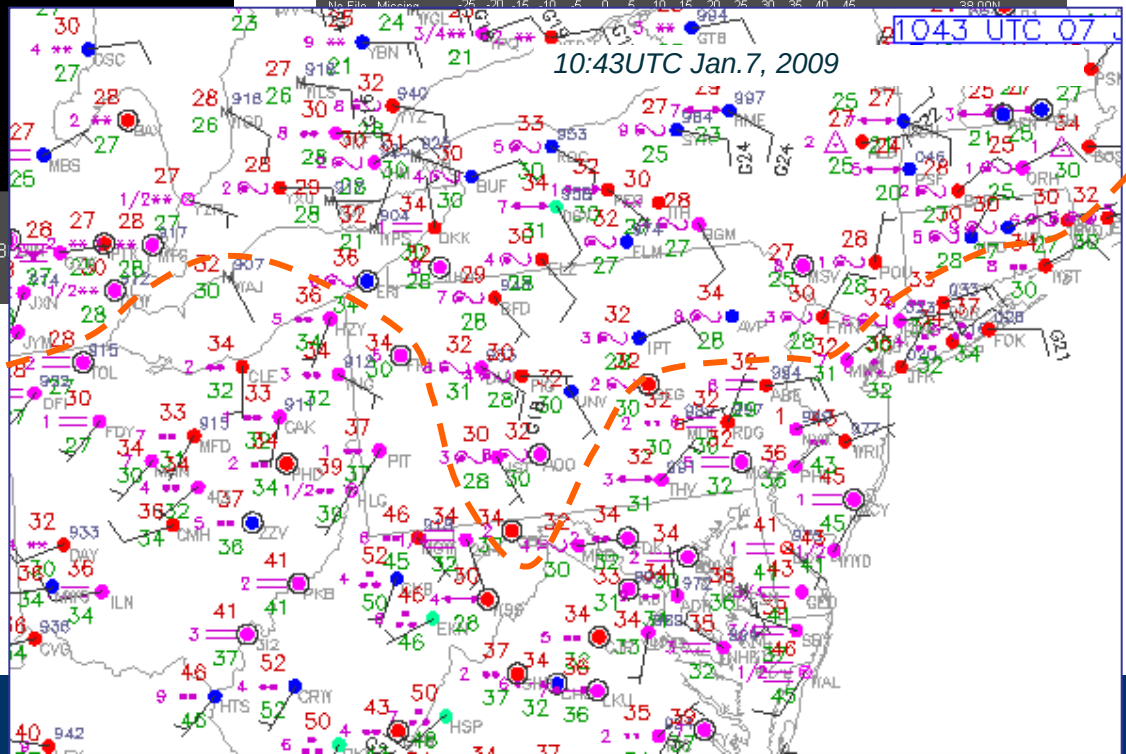

Q2 [Radar Only]
1hr QPE Accumulation
Valid Period:
05/02/2010 11:00:00 - 05/02/2010 12:00:00 UTC
Q2
Terrain Background [x100m]
None 6 8 10 12 15 20 25 30 35
Precipitation [in]
Min=0.00,Avg=0.05,Max=3.16
0.01 0.05 0.10 0.15
0.15 0.20 0.40 0.60 0.80 1.00 1.25 1.50 1.75 2.0 2.5 3.0
40.00N
94.00W
78.31 W
32.00N


Q2 [Radar Only]
24hr QPE Accumulation
Valid Period:
05/01/2010 12:00:00 - 05/02/2010 12:00:00 UTC
Q2
Terrain Background [x100m]
None 6 8 10 12 15 20 25 30 35
Precipitation [in]
Min=0.00,Avg=0.99,Max=13.57
0.01 0.10 0.25 0.50
0.50 0.75 1.0 1.5 2.0 2.5 3.0 4.0 5.0 6.0 8.0 10.0
40.00N
94.00W
78.31 W
32.00N

Rain/Snow Delineation

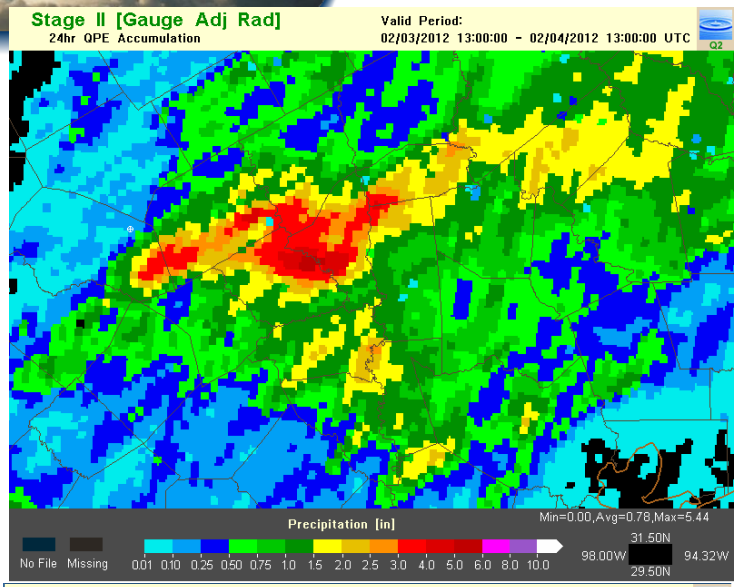


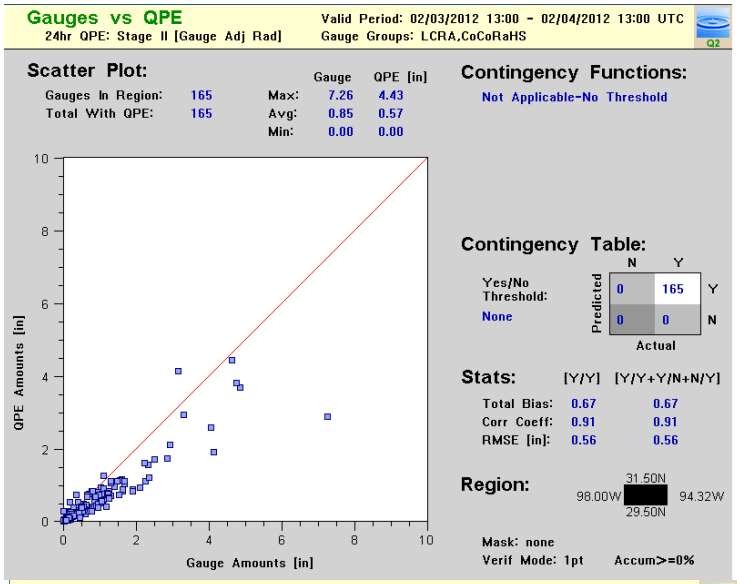


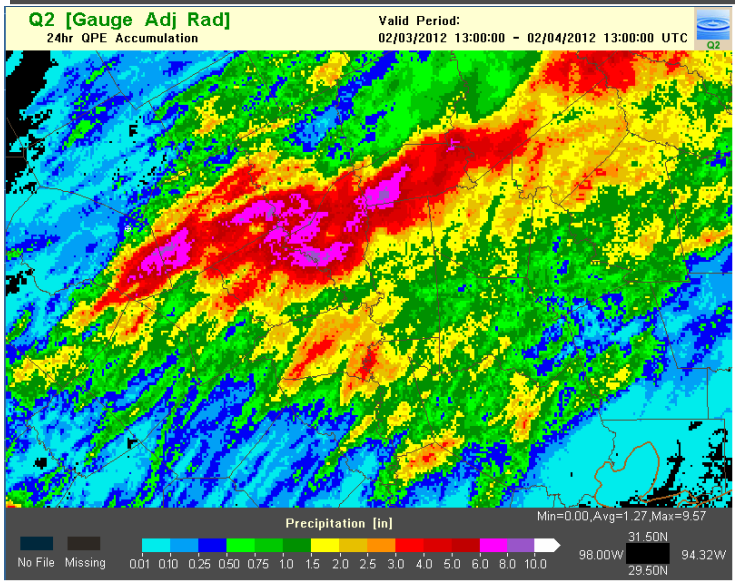


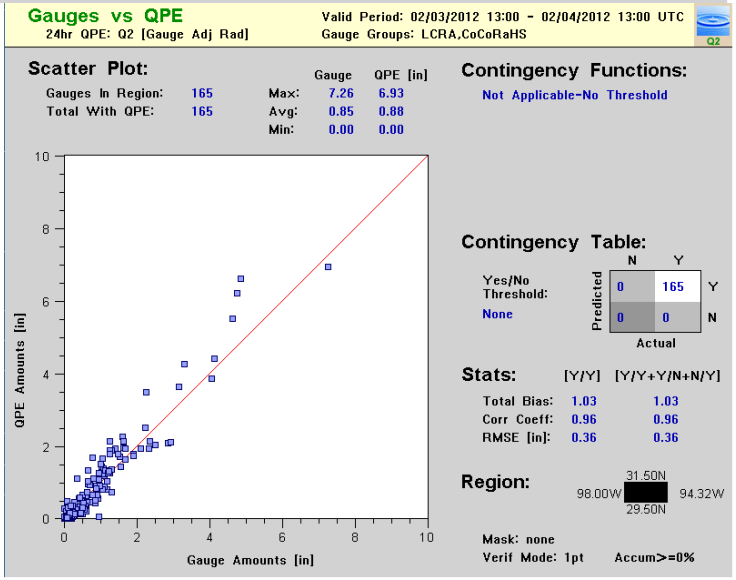
Environmental data is very important for precipitation classification: even with dual-pol radar.

2/4/2012 Texas HP Event





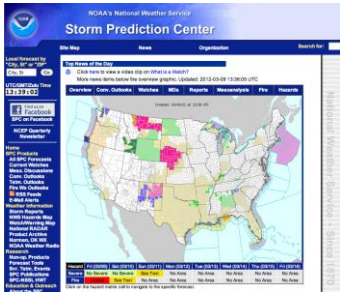


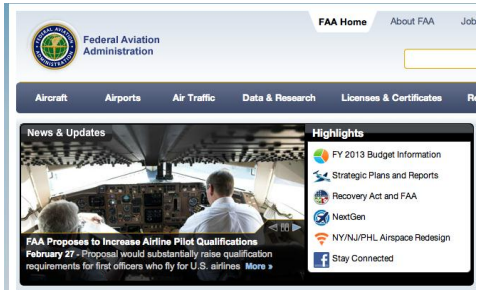


Precipitation and Diagnostic Products

	Product	Candidates?	System or Publisher	Comments	Product Resolution/ Area	Update Frequency (minutes)	Product Format	Min/Max Size (bytes)	Short Title	Abstract	Keywords	Coordinate Reference System	Spatial Resolution	Lat/Lon Bounds NW	Lat/Lon Bounds SE	Data History (temporal exent)	Responsible Party
Precipitation Products																	
	Surface Precipitation Phase (Frozen/Liquid)	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	10K/2M	PRCP_TYPE	Spatial distributions of rain/snow. Zhang, J., K.	precipitation classification	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	Surface Precipitation Type (Convective/Stratiform/ Tropical/Hail/Snow)	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Ncdf	10K/2M	PRCP_FLAG	Spatial distributions of different precipitation regimes (snow, convective rain,	precipitation classification	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	Precipitation Rate	Yes	NSSL HMRG	Exists: nmqxrt-2-5 Q2 Rad-only (tiled)	1x1km/ CONUS	5	Ncdf	10K/2M	PRECIPRATE	Instantaneous precipitation rate (mm/hr). Zhang, J., K.	precipitation intensity	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	Precipitation 1-hour Accumulation	Yes	NSSL HMRG	Exists: nmqxrt-2-5 Q2 Rad-only (tiled)	1x1km/ CONUS	5	Ncdf	500K/5M	RAD_1H_ACC	One-hour precipitation accumulation ending at the	precipitation accumulation	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	Precipitation 3-hour Accumulation	Yes	NSSL HMRG	Exists: nmqxrt-2-5 Q2 Rad-only (tiled)	1x1km/ CONUS	5	Ncdf	1M/15M	RAD_3H_ACC	three-hour precipitation accumulation ending at the	precipitation accumulation	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	Freezing Level Height	Yes	NSSL HMRG	Exists: nmqxrt-17 model remap	10x10km/ CONUS	60	Ncdf	500K/5M	FREEZING_LVL	freezing level height field from the RUC analysis.	freezing level	EPSG 3786	0.1x0.1 deg (10x10km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	Brightband Top Radar/RUC derived	Yes	NSSL HMRG	Exists: nmqxrt-27 bbid_hgts + bb_analysis	1x1km/ CONUS	5	Ncdf	1M/2M	BB_TOP	2-D bright band top level analysis obtained by	freezing level, bright band	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	Brightband Bottom Radar/RUC derived	Yes	NSSL HMRG	Exists: nmqxrt-27 bbid_hgts + bb_analysis	1x1km/ CONUS	5	Ncdf	1M/2M	BB_BOTTOM	2-D bright band bottom level analysis obtained by	freezing level, bright band	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
Radar Diagnostic Products																	
	Radar Quality Index	Yes	NSSL HMRG	Exists: nmqwd36 SHSR Mosaic	1x1km/ CONUS	5	Ncdf	1M/2M	RADAR_QUALITY_INDX	A dimensionless field representing the spatial	radar QPE quality, uncertainty	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	Radar Coverage	Yes	NSSL HMRG	Exists: nmqwd36 SHSR Mosaic	1x1km/ CONUS	5	Ncdf	500K/5M	RADAR_COVERAGE_MAP	Areas within 460km radius of all radars that are online at the	radar coverage	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	NSSL
	Radar VCP	Yes	NSSL HMRG	Exists: nmqxrt-2-5 3D Mosaic (tiled)	1x1km/ CONUS	5	Text file	500K/5M	RADAR_VCP	A display indicating what volume scan mode each radar	Radar volume scan mode, Volume Coverage Pattern, real	EPSG 3786	0.01x0.01 deg (1x1km)	55.005, -130.005	19.995, -59.995	24-hrs	

MRMS/Q2 Grid Distribution Collaborators





Environment Canada Environnement Canada

unidata

NCAR

UCAR

NASA

USGS
science for a changing world

NOAA's National Weather Service
Radar Operations Center
NEXRAD WSR-88D

MRMS

Products

And Diagnostics

Central Weather Bureau

WRA

SRP

Salt River Project

Stand Alone MRMS Systems

NOAA's National Weather Service
Advanced Hydrologic Prediction Service

NOAA's National Weather Service
Office of Hydrologic Development

NOAA's National Weather Service
Office of Climate, Water, and Weather Services

Earth System Research Laboratory
Serving Society through Science

National Oceanic and Atmospheric Administration
Great Lakes Environmental Research Laboratory

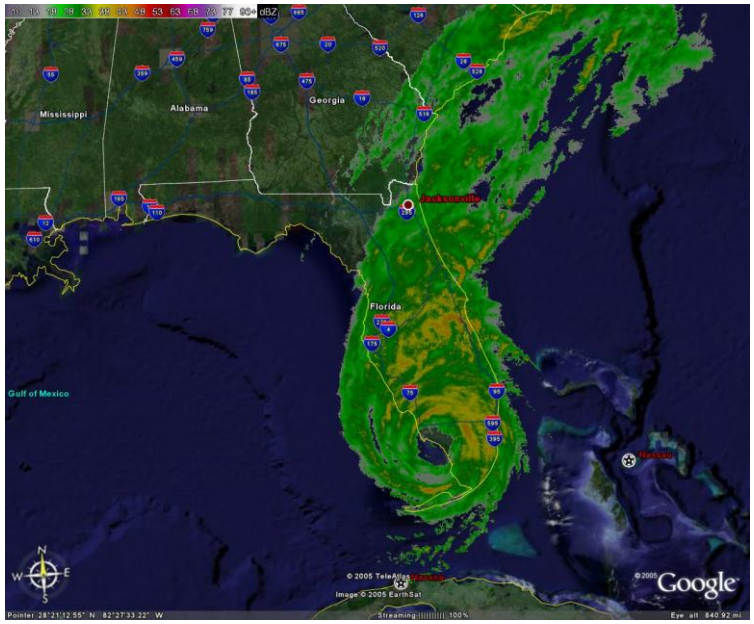
National Oceanic and Atmospheric Administration
Hydrometeorology Testbed Program

KML Products (Google Earth)

http://nmq.ou.edu/qvs-2012.html

http://wdssii.nssl.noaa.gov/

- *Live MRMS products for the CONUS.*
- *Severe storm analysis products derived from 3D reflectivity fields and environmental data*
- *Multi-radar reflectivity products (1 km, 5-minute updates)*
- *Multi-radar Doppler velocity products (0.5 km, 2-minute update)*
- *12,000+ unique users (including NWS), 4M hits per month*



MRMS 'Operational' Status

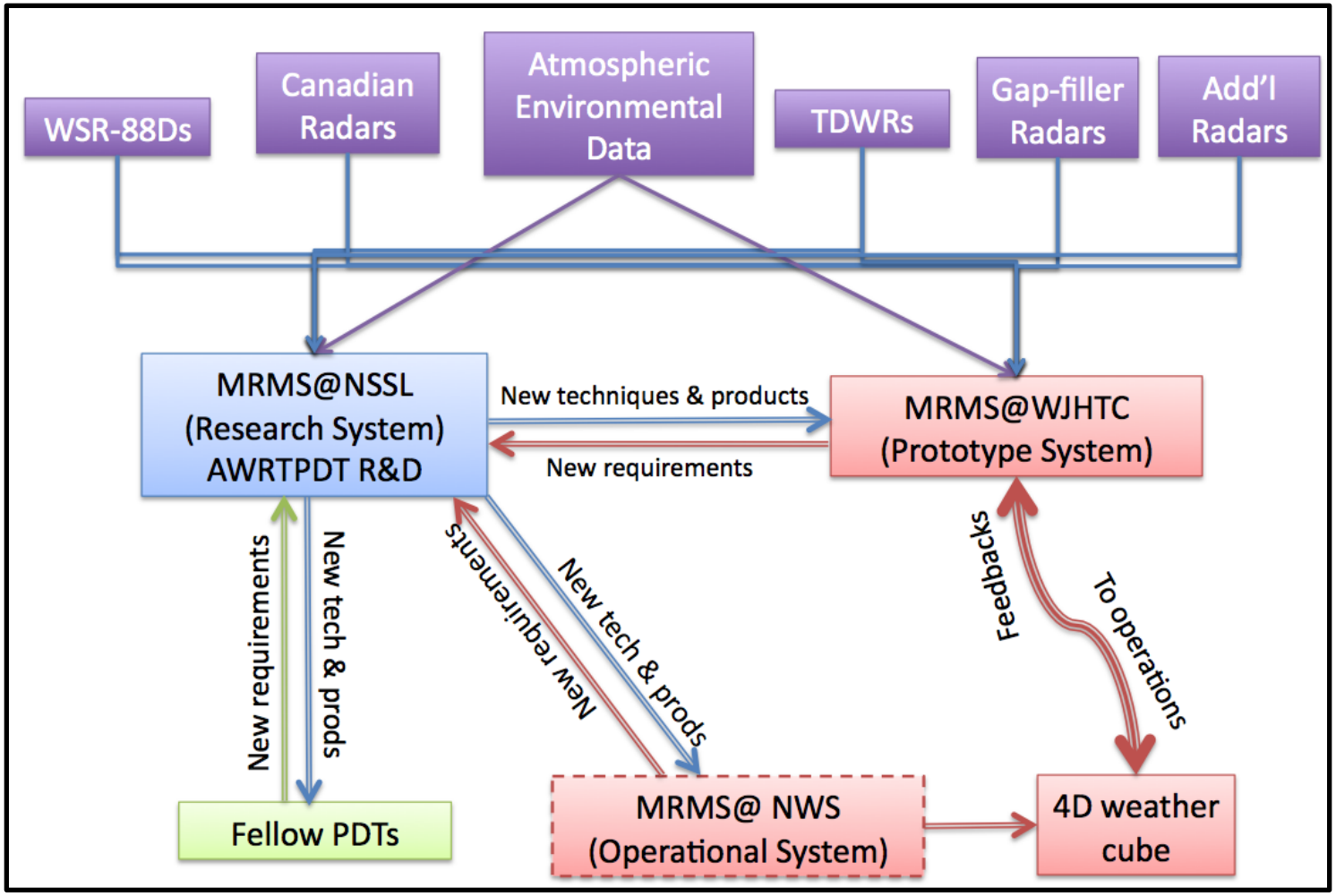
Approval of the National Severe Storms Laboratory Multiple-Radar / Multiple-Sensor (MRMS) weather decision support system as an official NOAA Line Office Transition Project (**December 2010**)

Exploring possible implementation on NCEP's new supercomputer

Implemented at FAA WJHTC for research and development (30sec CONUS product generation)

MRMS - FAA and NextGen

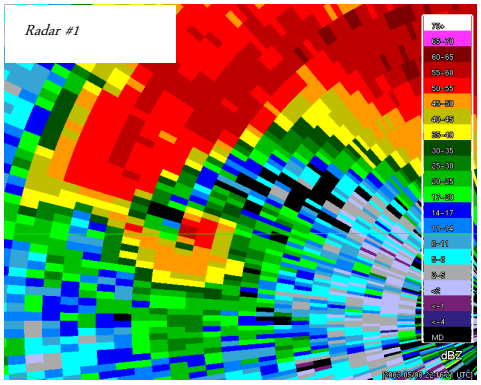
The AWRT PDT research and development work flow

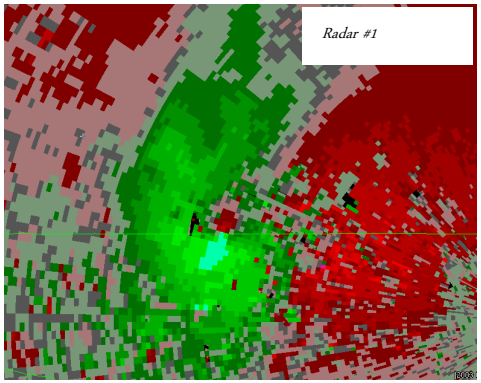


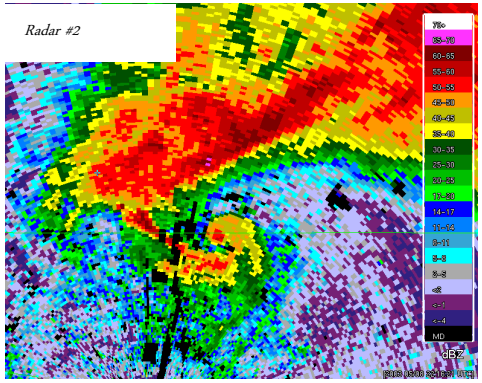
MRMS Products in development for FAA and NOAA (FY13/14)

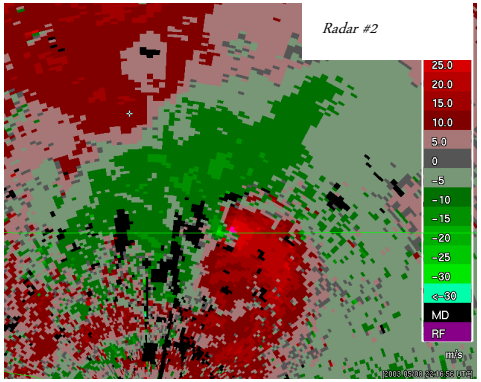
Product Name	MOU/end user	Description
CREF_DPQC	FAA/FAA	2-D national mosaic of composite reflectivity, derived from QC'd base level reflectivity using dual-polarization radar techniques
HHC_mosaic	FAA/FAA	2-D national mosaic of NWS operational hydrometeor classification products at the lowest unblocked radar observation levels
MREFL_3D_DPQC	FAA/FAA	3-D national mosaic of base reflectivity that are QC'd using dual-polarization radar techniques
Q3rad_baseline: rate	OAR/RFCs, FOs	2-D national mosaic of precipitation rate, computed from the NWS operational polarimetric radar QPE [synthetic method based on fixed R(Z), R(Z,Zdr), and R(Kdp)].
Q3rad_baseline: accumulations	OAR/RFCs, FOs	1- to 72-h precipitation accumulations
HC_3D	FAA/FAA	3-D national mosaic of hydrometeor classicfications

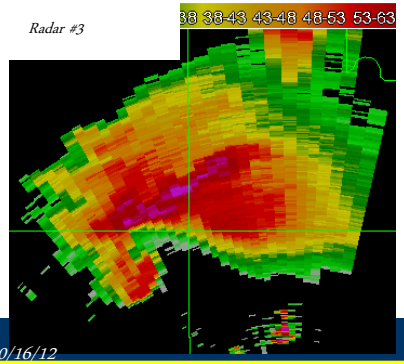
A better alternative?

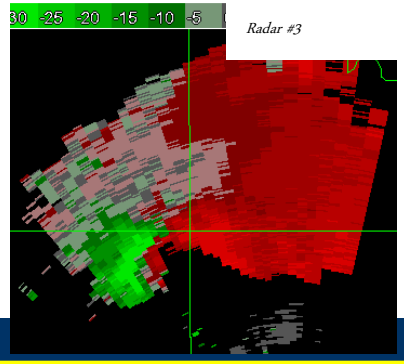


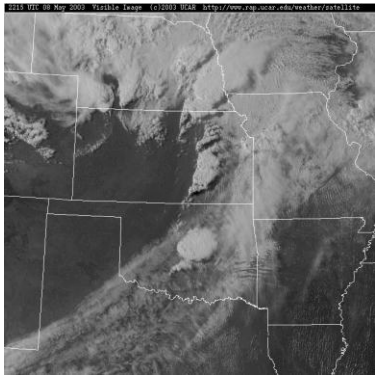


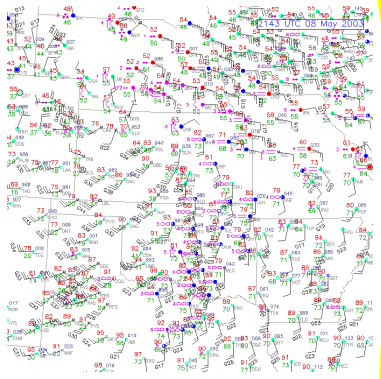


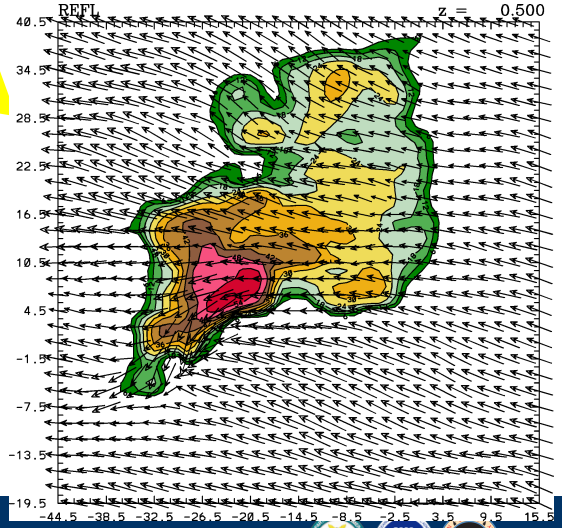




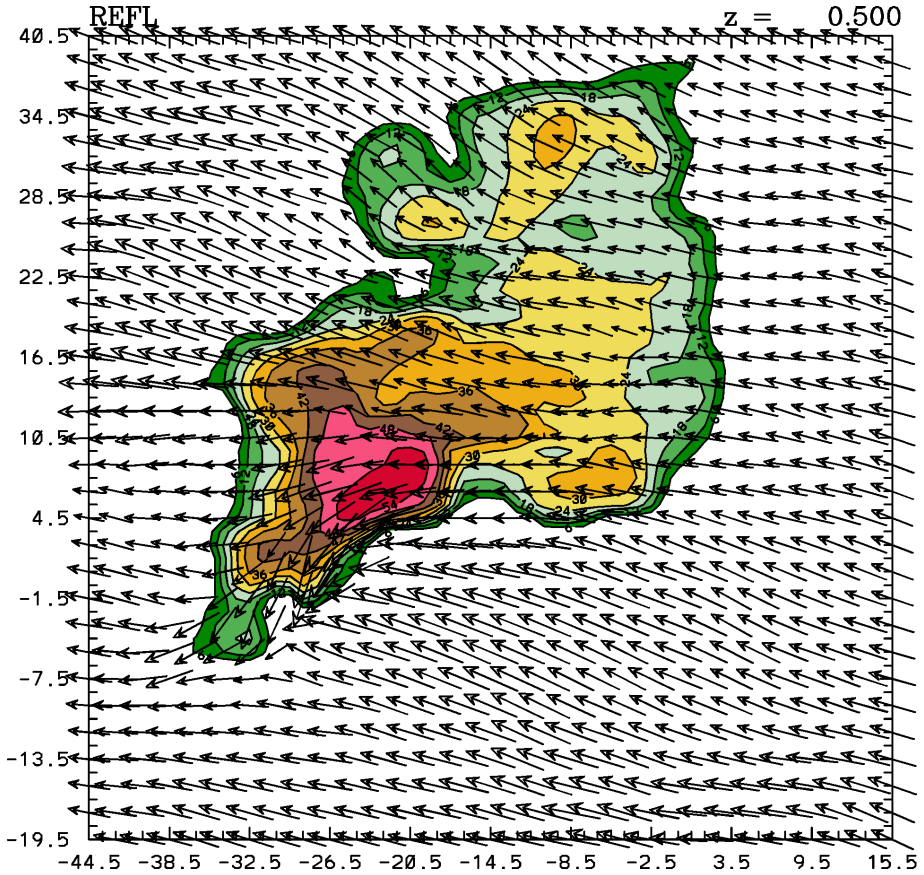








Single unified 3D analysis



3D Wind (U/V/W)

Solve vorticity equation

Pres/Temp/RH

Rapidly Updating Analysis

- Major focus of the NWS Science and Technology Roadmap is to provide increased situational awareness for forecasters
- A rapidly updating analysis (RUA) of the physical environment (atmosphere, land, hydrology, ocean and cryosphere), is the first step.
- The RUA will be produced centrally at NCEP from a national collection of observations (radar, satellite, surface stations, aircraft, rawinsondes, etc).

The What and Why?

The RUA will generate real-time analyses of precipitation, radar reflectivity, clouds, temperature, moisture, wind, hazardous chemicals and others fields required by forecasters to generate warnings and forecasts with greater lead time and accuracy than today

The MRMS/Q2 is the initial step towards the RUA

RUA and WRN

- RUA will be a foundational piece of WRN Operations
- End-to-End Implementation of RUA demands a broad-based effort involving NWS, OAR, and NESDIS.
- RUA implementation **will set the stage for Warn on Forecast**
- The RUA Program would be an excellent proof-of-concept R2O-O2R project for the proposed Science and Technology Infusion Center (STIC)

How?

Software base

- Operational Gridpoint Statistical Interpolation (GSI) code
  - Community-based software development using collaborative, disciplined software management
  - NWS, NASA, NESDIS, OAR, NCAR participation
  - Port MRMS Capability to GSI – OAR support
- Generalization of surface Real-Time Mesoscale Analysis (RTMA)
- Ingests all operational observations (temperature, wind, humidity, surface pressure) from
  - Rawinsondes
  - Aircraft
  - Surface
  - Geostationary and polar-orbiting satellite instruments
  - Radar
- Analysis development
  - Vertically nested system with increased resolution in PBL compared to mid-troposphere

RUA Scientific Development Areas

- Cloudy radiances
  - Surface emissivity
  - Partial cloudiness
- Cloud analysis
- Radar reflectivity and precipitation (GSD)
- Complementary use of microwave satellite and radar data
- High time density data (e.g. radar, GOES-R)
- Bias (background and observations)
- Platform-specific quality control
- Downscaling of background

THE NCEP REAL-TIME MESOSCALE ANALYSIS (RTMA)

Manuel Pondeca, Geoff Manikin , David Parrish, James Purser, Geoff DiMego, Stan Benjamin, John Horel, Lee Anderson, Brad Colman, Greg Mann, and Greg Mandt

Mesoscale Modeling Branch

National Centers for Environmental Prediction

Manuel.Pondeca@noaa.gov

301-763-8000 ext 7734

NOAA Science Center-Room 207

5200 Auth Road

Camp Springs, MD 20746-4304

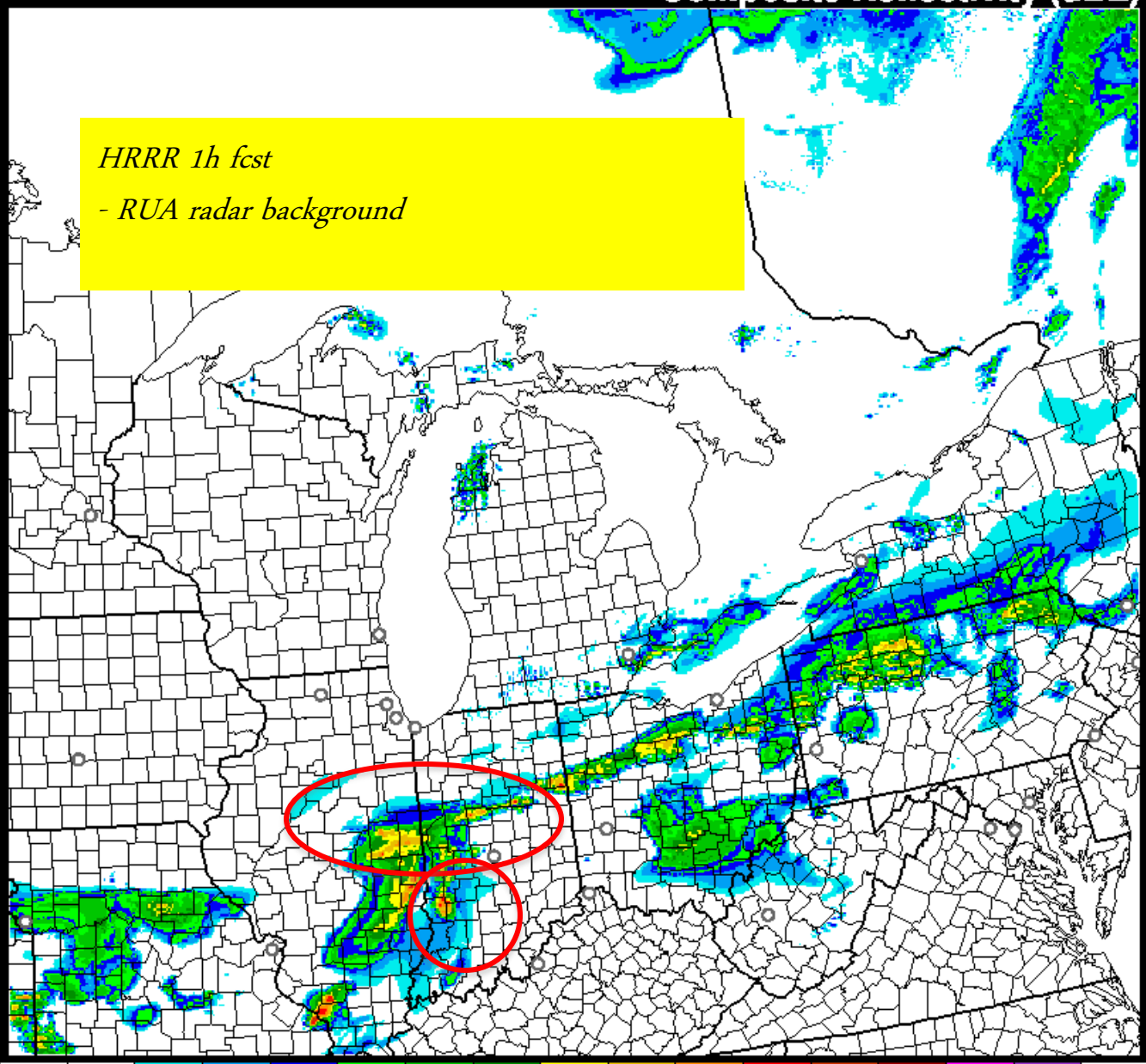
Proposal for initial RUA cloud/hydrometeor fields

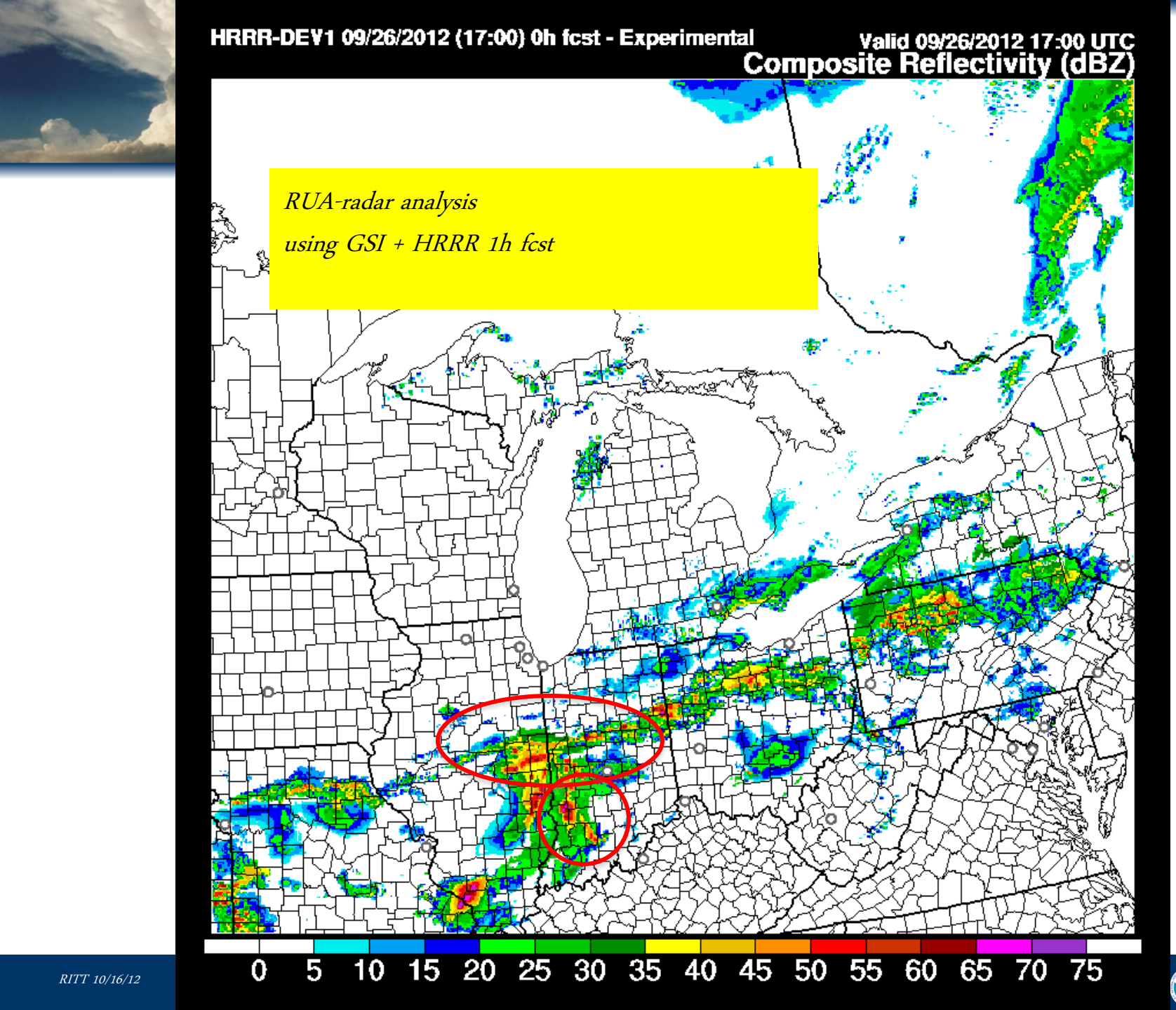
Use GSI non-var cloud analysis

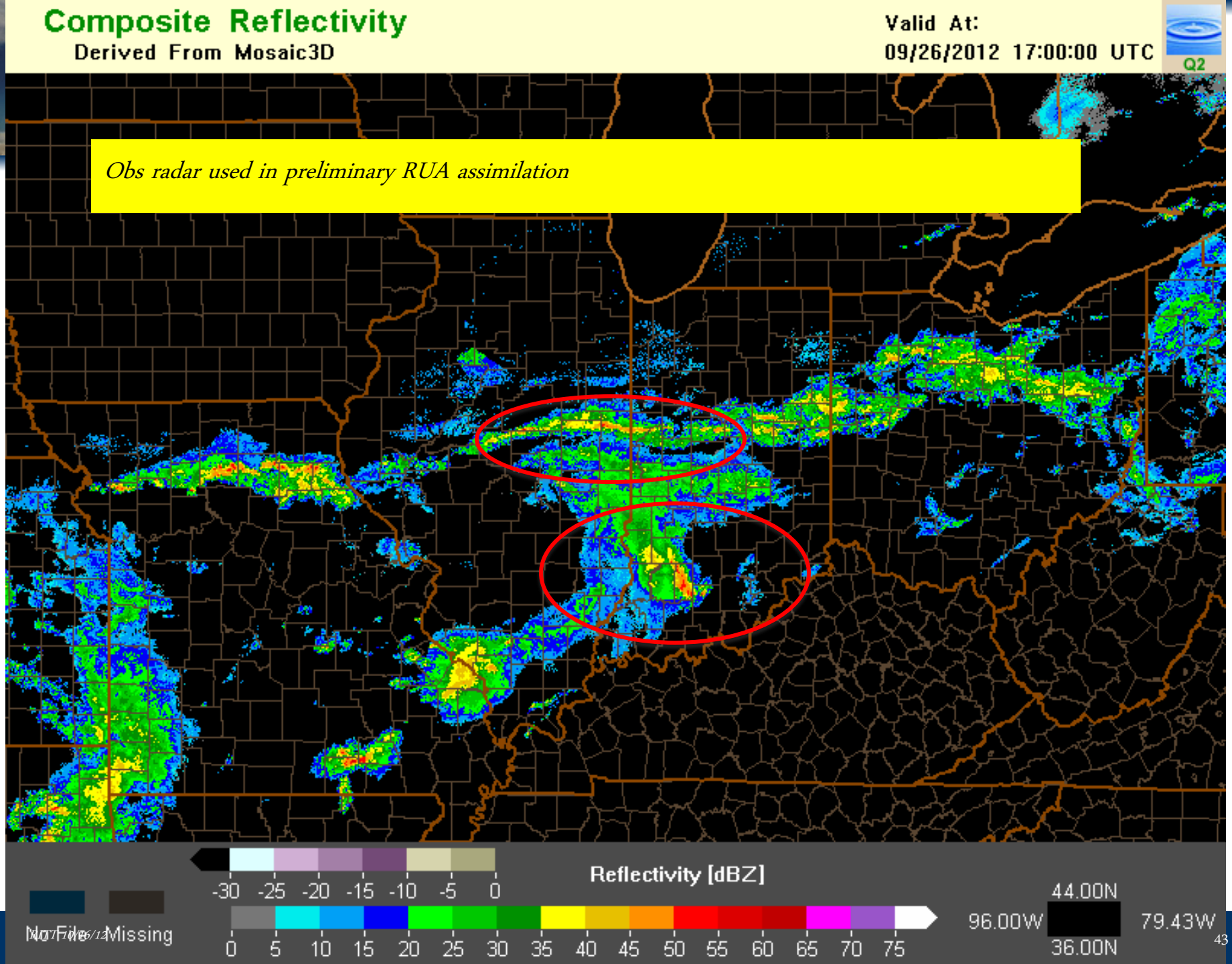
- *Use HRRR 1h forecast – experimental background*
- *Map onto model prognostic variable 3-d cloud hydrometeor grids (cloud water, ice, size bins)*
- *Differences from RAP/HRRR settings for cloud analysis*
  - *Build clouds at all levels, all stabilities, no dtemp criteria for marine stratus, etc.*
  - *Aggregate FOVs only to nearest grid point.*
  - *Use cloud fraction option in GSI to capture sub-gridscale (even at 2.5-3km)*

Use GSI 3-d radar 3-d assimilation (non-var for now, using radar-LH-DFI method inside model after GSI pre-processing)

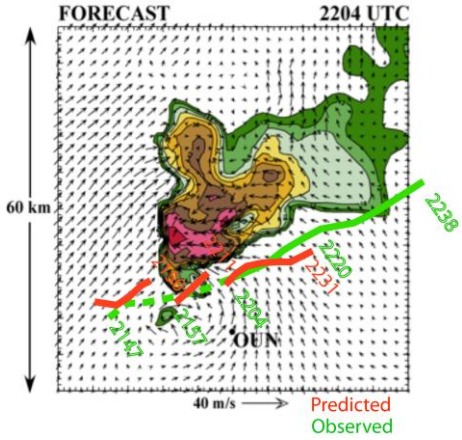
- *Map onto model prognostic variable 3-d precipitation hydrometeor grids (rain water, snow, graupel)*


HRRR-DEV1 09/26/2012 (16:00) 1h fcst - Experimental
Valid 09/26/2012 17:00 UTC
Composite Reflectivity (dBZ)
HRRR 1h fcst
- RUA radar background
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75


HRRR-DEV1 09/26/2012 (17:00) 0h fcst - Experimental
Valid 09/26/2012 17:00 UTC
Composite Reflectivity (dBZ)
RUA-radar analysis
using GSI + HRRR 1h fcst
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75


Composite Reflectivity
Derived From Mosaic3D
Valid At:
09/26/2012 17:00:00 UTC
Q2
Obs radar used in preliminary RUA assimilation
Reflectivity [dBZ]
-30 -25 -20 -15 -10 -5 0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75
No File
Missing
44.00N
96.00W
36.00N
79.43W

Begin



Early delivery products (via MRMS)

- Severe weather
  - Lightning probability
  - Wind shear
  - Hail probability, size and geo distribution
- Precipitation
  - Type
  - Rate, 1,3 hour accumulation
  - Reflectivity analysis and Vertical Profile of Reflectivity (VPR)
  - Volume integrated liquid water (VIL)
- May 2013 (experimental potentially on new NCEP computer)

Scientific development

- 2-5 years to implement, given adequate funding
- Prototype (Autumn 2013)

Thank you !

Real-Time Mesoscale Analysis (RTMA)

The Real-Time Mesoscale Analysis (RTMA) is a NOAA/NCEP high-spatial and temporal resolution analysis/assimilation system for near-surface weather conditions.

Its main component is the NCEP/EMC Gridpoint Statistical Interpolation (GSI) system applied in two-dimensional variational mode to assimilate conventional and satellite-derived observations.

The RTMA was developed to support NDFD operations and provide field forecasters with high quality analyses for nowcasting, situational awareness, and forecast verification purposes.

The system produces hourly analyses at 5 km and 2. 5 km resolution for the Conus NDFD grid.